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AMERICAN POTASH INSTITUTE, INC.

INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

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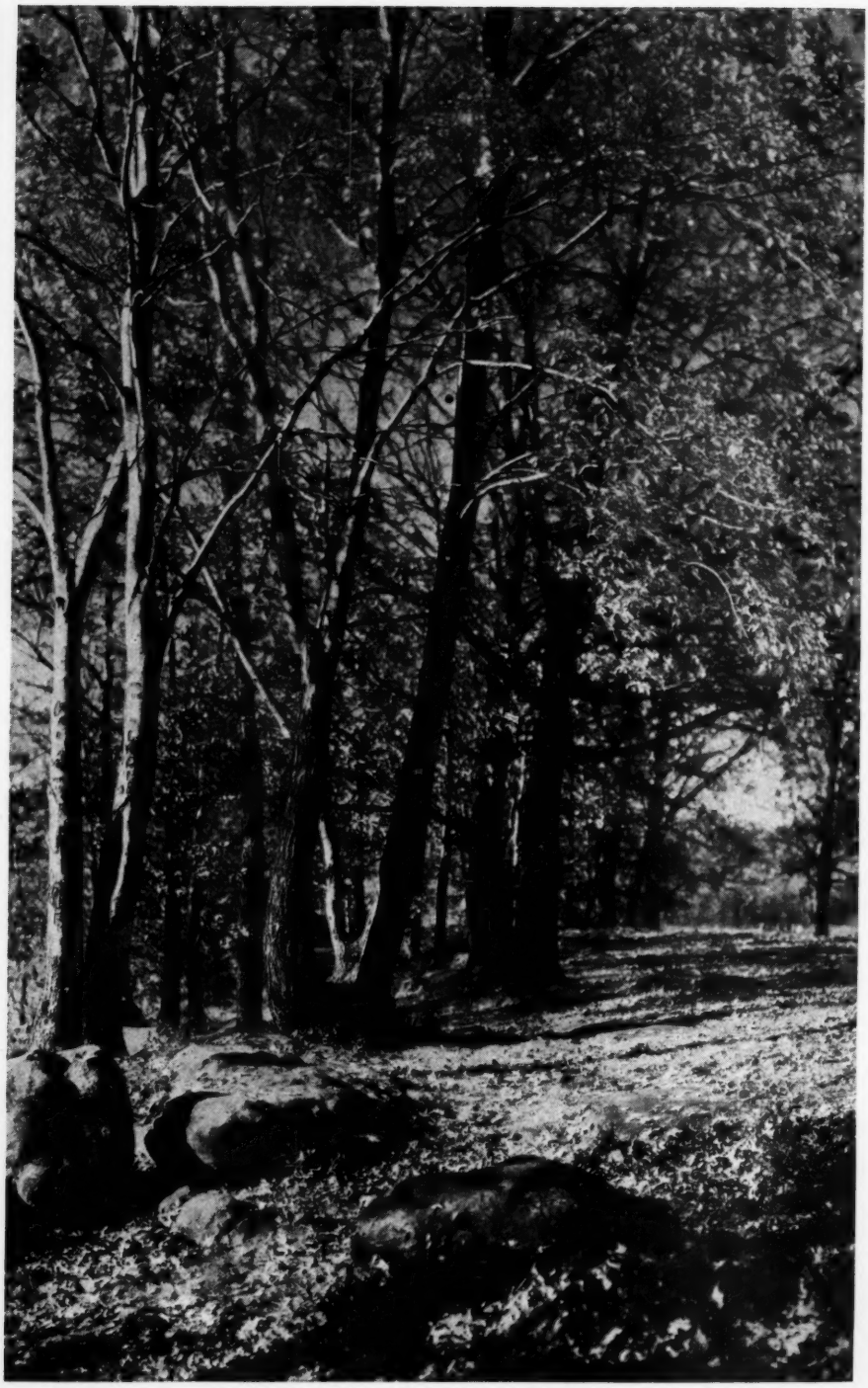

"There is a harmony in autumn, and a lustre in its sky."

—Shelley

Better Crops with PLANT FOOD

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VOL. XXII WASHINGTON, D. C., OCTOBER 1938 No. 8

Better Schools Need You—

Present for Roll Call

By Jeff McDermid

THEY say a layman always knows more about running a school than the county superintendent, and I'm here to prove it! After all, most recent improvements in our rural schools have been planned by the PTA, financed by the PWA, and erected by the WPA, and all the teachers had to do was build the fires every morning and lick the dust out of the bullies. And so I approached my subject with all the ardor of a tyro, in blissful disdain of pedagogical libraries crammed full of the accumulated experience which nobody reads.

In the course of my bucolic travels I pass by hundreds of schoolhouses. I have seen the time when "passing" them would have been a treat, and I recall several times when I was blocked in my vain attempts to do so by stern parental discipline. Nowadays I sort of hanker to hunt up a few old dog-eared tomes and edge into a back seat, especially when a comely-looking girl has secured the contract. Strange how one changes his attitude toward such ordinary things, so that objects of former hatred turn into coveted goals, usually when it's rather too late to begin over again.

My choice of this topic does not lie in very intimate experience with rural schools as a board member or a text-book salesman. Sometimes, however, I have found mighty human stories

tucked away in one of these outposts of liberty. Most writers stay away from them because most successful writers were not able to use their imagination in lieu of grades in their student days, no matter how well they fooled the public subsequently.

SO when I was told by a county agent to stop at a certain school and meet the teacher, it sounded like a very alluring date. And so it proved to be. The teacher was a man. That up our way is in itself a week's wonderment. Men teachers have faded out of the picture in the open country. Moreover, this teacher was decidedly well-trained and qualified. Fellow students at normal with him were college profs and county supers. Not lack of ambition or "oomph" either. Even though this fellow had taught in this same district for thirty-five years straight, you couldn't pin a fault on his personality or ability. Just a queer, natural choice he had to stay right in the home school where his father and mother, himself and his brothers, and two of his children had "graduated."

Two hours of watching this chap handle the routine, a little close observation of the means and methods, and a quiet chat with him as he helped the kids with their noon-day hot lunch kit —that's all it needed to convince me. He is a farmer himself, lives two miles distant, milks his cows and does his own farm work when vacation comes —and ever and always his keynote runs to making that school spell rural character and community training, to retain tradition, and to teach civics with reference to town elections and town questions, as well as to what Congress promises to do for the farmer. Lean, spare, wiry, and gray, this fatherly old scout is probably going to mean more to several hundred farm folks in this generation than Henry Wallace or the ever-normal granary. He has not run away from his birthright and sought some glittering opportunity that didn't stay gilded. When his job is done I'll bet that district will miss him worse than the rain.

In some quarters it has become common to regard the task of teaching country schools as sissified. I know no young men, Future Farms or 4-H leaders, least of all agricultural college students, who would consent to teach their own district school or even one like it. They would hunt up a wild-eyed job with the NYA before subjecting themselves to sly sarcasm. I often wonder whose fault this is. It should not be tolerated. Perhaps one reason lies in the preponderance of young women who hold dominion over the destiny of graded rural schools. Everybody has come to think of it as a girlish avocation—but why sissified at that? Women hold several world records in athletics and aircraft operation, and see if you can find a nervier climber than Miss Bourke-White, photographer, or a better judge than Florence Ellinwood Allen.

MANIFESTLY, that is not the chief reason. The real reason is that too many of our school systems have degenerated teachers, regardless of sex, into petty disciplinarians and dogmatic text-book followers, kindergarten nurses, and narrow pluggers.

We are coming into an era, thank heaven, when the folks who support school districts are certain that education does not end when one grabs an important looking eighth grade certificate. The new idea of schooling insists that educational advantages set up at public expense belong to the entire community and not just to the immature pupils, the teacher, and the county super.

My second objection to past principals in secondary schools lies in their general inclination to prepare all pupils for a higher educational career or for professional services in cities. I have no bone to pluck with academic studies or cultural branches as such, but when the whole effort of a school methodism is directed absurdly to making lawyers, doctors, preachers, and professors out of mighty fine farm timber, they are doing the world no service. We are

happy to see that our new rural school curriculum is aimed more particularly at instruction, more closely related to the practical duties and everyday problems which the graduate must face and conquer.

Mind you, I realize that one can turn further in the opposite direction than

seems just and sound. That is, you can run all country pupils through a rural mold regardless of natural inclination of the individual and make as much of a mistake in that way as when you focus all attention on fitting them for thinking while dragging and planning while canning.

BUT on the whole some of those individuals will find a way of escape from an intolerable or unsatisfactory schooling, and eventually reach their professional goals; while to ram and cram the usual mine-run of country kids with dogmatic academic courses preliminary to city careers is serious malfeasance.

In the educational history of my own State we pay homage to a man who fathered the system of free education. Previous to his coming, schools were supported by tuition entirely and leaned toward super careers and professional backgrounds. But we may not have emancipated the schools merely by making them free in a monetary sense. Schools are not free completely unless they direct their energies to local community upbuilding and pride in the production of competent rural leadership. They are not free unless they can point with pleasure to men and women emerging from their domain who created a better home environment and established sounder country institutions.

Hitherto so many principals of secondary schools in strictly rural regions have congratulated themselves smugly on preparing many graduates for college entrance. They maintain rosters of successful ones who made good in metropolitan centers and shout that the country is the breeding ground for the strongest non-farm careers. I see in the newer movement a tendency to emphasize graduates who find a wholesome reward in doing worthy things at home. The country cannot be built up simply by supplying country-minded specialists to cities. True, they help us interpret farm life where there is grave mistrust and ridicule, but we insist upon keeping our farm leaders at the plow for best results.

ONE thing happened to me which stamped that point indelibly. In my duties as a writer for farmers, I once attended a rural school reunion. There were the customary handshakes and smiles; the muddle of cakes, salads, hearty meats, and condiments spread upon the outdoor tables. The oldest teacher was there, three former county supers, and some friendly townsmen out for a lark. When it came time to take the pictures, they all posed for me, including one village banker, a fine local farmer, and the erstwhile aged teacher of other days. The old lady remarked that the banker and the husky farmer were her bright pupils, and she wanted to know what each one thought of the new schoolhouse and the progress of the district.

Mr. Banker said he had loaned the board several hundred dollars to erect the new structure, and in fact, he had sort of gone into the school-loan business generally of late. Why, I asked. His answer was that it was profitable

(*Turn to page* 46)

Potash Saves Alfalfa, Clover, and Soybeans

By A. W. Blair and A. L. Prince

New Jersey Agricultural Experiment Station, New Brunswick, New Jersey

CERTAIN of the plots at the New Jersey Agricultural Experiment Station have been used in a soil improvement project for about 20 years. The 5-year rotation, as planned in 1918, provided for four 1/20-acre plots designated as Section 1, with corn, oats, wheat, and 2 years of timothy as the crops, and four other 1/20-acre plots designated as Section 2, with corn, oats, wheat, and 2 years of timothy and clover (later alfalfa was included in the mixture). The plan further provided that any green manure crops grown should be, for Section 1, non-legumes, and for Section 2, legumes.

This plan was carried through for the greater portion of the 20 years, but some changes have been made during the past 5 or 6 years, due to the fact that weeds came in to such an extent that the crops were of little value. For example, timothy was seeded on the non-legume section, and a timothy-clover-alfalfa mixture on the legume section in August 1935. By the summer of 1936 the weeds were so bad that it became necessary to plow all the crops under, and in June of that year Sudan grass was seeded on the non-legume section and soybeans on the legume section.

Considering for the present only the hay crops grown during the 20 years, the crops for the non-legume section were as follows: for 1921 and 1922; 1926 and 1927; 1931 and 1932—timothy. Timothy was also seeded on this section in 1935 but, as explained above, weeds choked it out and Sudan grass was seeded in its place. Following the Sudan grass, wheat was seeded about the first of October 1936, and following the wheat, a timothy-clover-alfalfa mixture was seeded in August 1937 (this seeding should have been timothy only).

For the legume section, the crops were as follows: timothy and clover for 1921 and 1922, and 1926 and 1927. In August 1930, a timothy-clover-alfalfa mixture was seeded for the 1931 and 1932 crops. The same mixture was seeded again in August 1935, but, as explained above, this failed on account of weeds, and these plots were seeded to Wilson soybeans in June of 1936. Following the soybeans, wheat was seeded as for the non-legume section, and this was followed by alfalfa seeded in August 1937.

Fertilizer Treatment

The fertilizer treatment is shown in table 1, which also gives the yields of hay in pounds per acre on the two sections for the years mentioned. Lime has been applied at intervals to maintain the reaction of the soil at about pH 6.0—7.0.

It will be noted that half the plots have received no potash since 1918, and that the others have received only a moderate application.

The grain crops have not shown a very distinct response to the potash treatment, but the legume crops have been definitely benefited. Reference to table 1, non-legume section, shows an 8-year average of 715 pounds more of

TABLE 1.—INFLUENCE OF POTASSIUM ON LEGUME AND NON-LEGUME CROPS (POUNDS OF HAY TO THE ACRE)

Non-legume Section

Crops: / Fertilizer Treatment*	Timothy 1921	Timothy 1922	Timothy 1926	Timothy 1927	Timothy 1931	Timothy 1932	Sudan Grass 1936	Timothy Clover Alfalfa 1938	8-year Average
N P *a*	2,070	2,440	1,772	2,953	1,676	1,154	2,062	2,691	2,102
N P K *b*	2,650	3,552	2,372	3,412	1,867	1,529	2,128	5,029	2,817

Legume Section

Crops: / Fertilizer Treatment	Timothy Clover	Timothy Clover	Timothy Clover	Timothy Clover	Timothy Clover Alfalfa	Timothy Clover Alfalfa	Soy-beans	Alfalfa	8-year Average
P *c*	1,800	3,790	1,736	1,827	1,587	2,057	2,365	1,529	2,086
P K *d*	3,551	5,260	3,105	3,811	4,234	3,842	3,045	4,375	3,903

* The figures in each case represent the average for two plots.

a Nitrogen equivalent to 160 lb. of nitrate of soda to the acre. Phosphorus equivalent to 300 lb. 16% superphosphate to the acre.

b Nitrogen and phosphorus as in "a"; potassium in the form of muriate at the rate of 50 lb. to the acre (the muriate was increased to 100 lb. to the acre in 1936).

c Phosphorus as in "a."

d Phosphorus and potassium as in "b."

Fig. 1. Left: Soybean plants from potash-treated plots. Right: Plants from potash-deficient plots.

hay for the potassium-treated plots than for those without potassium. This is a 34 per cent increase. For the legume section, there is an 8-year average increase of 1,817 pounds to the acre for the potassium-treated plot over the plot without potassium. This is an increase of 87.1 per cent. In this connection it may be pointed out that not only is the quantity of hay increased, but the nutritive value is also improved, as shown by the percentage of nitrogen in the crop (see table 2). With only two exceptions (timothy in 1921 and 1926, non-legume section), the hay from the potassium-treated plots shows a higher percentage of nitrogen than that from the no-potash plots. It is true that the differences are not great, but they are distinctly greater for the legume than for the non-legume crops, the former showing an 8-year average increase of 0.24 per cent nitrogen for the potassium-treated plots, which is equivalent to 1.6 per cent protein. The low percentage of nitrogen in the first cutting of alfalfa in 1937 is due to the fact that during the

early part of the season there was an abundant growth of camomile (Anthemis Arvensisl) on these plots, and although the alfalfa outgrew this, there was enough to lower the percentage of leaves turned yellow early and small white spots formed around the margins, and the stand was uneven. Many weeds came in to crowd out the alfalfa. Clover was affected much the same as alfalfa.

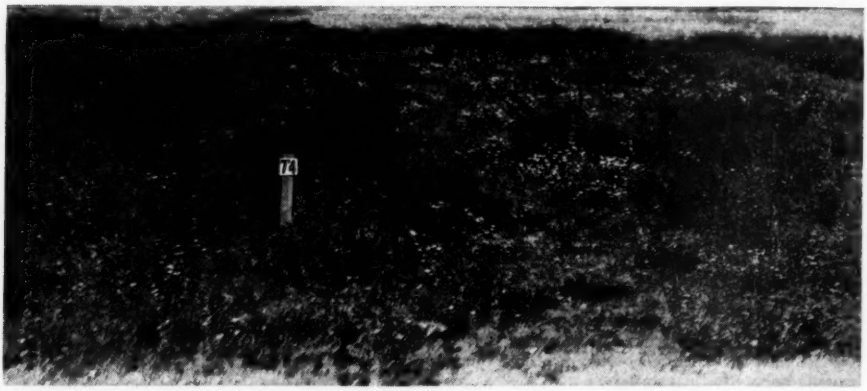

Fig. 2. Alfalfa (Plot 74) on Sassafras loam soil which has not received potash treatment since 1918. Note the short growth and abundance of weeds.

nitrogen. The second cutting was entirely free from weeds.

Potash Deficiency Symptoms

On the no-potash plots the alfalfa was short and stunted in growth, the The soybean plants were short and stunted, lower leaves turned yellow before the plants blossomed, and the root system was small with only a few small nodules. Some of these symptoms

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TABLE 2.—PERCENTAGE OF NITROGEN IN CROPS GROWN WITH AND WITHOUT POTASH TREATMENT

Non-legume Section

Crops / Fertilizer Treatment*	Timothy **	Timothy ***	Timothy	Timothy	Timothy	Timothy	Sudan Grass	Timothy Clover Alfalfa	Average
	1921	1922	1926	1927	1931	1932	1936	1938	
N P	.92	1.03	.78	.79	.86	.95	.64	1.39	.92
N P K	.83	1.09	.78	.90	.89	1.05	.66	1.77	.99

Legume Section

Crops / Fertilizer Treatment*	Timothy Clover	Timothy Clover	Timothy Clover	Timothy Clover	Timothy Clover Alfalfa	Timothy Clover Alfalfa	Soy-beans	Alfalfa	Average
P	1.14	1.74	.84	1.13	1.38	1.74	2.63	1.34	1.49
P K	1.17	1.90	.99	1.29	1.99	2.03	2.75	1.68	1.73

* The figures in each case represent the average of two plots. Fertilizer treatment the same as indicated in table 1.

** These figures represent percentage of nitrogen in the hay from the first cutting. The legume section gave a second cutting which averaged about 2.3% nitrogen.

*** These figures represent the percentage of nitrogen in the hay from the first cutting. All the plots gave a second cutting, largely clover, the nitrogen content of which was about 1.8%. There was much volunteer clover in the non-legume section.

Balanced Fertilizers Make Fine Oranges

By M. E. McCollam

San Jose, California

THE success of an individual grower, or of growers grouped into an industry such as the citrus industry, depends a great deal on the necessary ability to weigh the good and bad in any plan, as well as to exercise the necessary energy in somehow putting promising plans into action.

Allen Break, orange grower and shipper of Redlands, California, has sorted out many ideas and plans in his business thus far, and has chosen wisely the practices he follows. One decidedly gets the impression, too, that Mr. Break extends his wisdom in business to a fine plan for living and service in his community.

He has been associated with citrus fruit production in Southern California since 1898, when he came to Pomona from Peabody, Kansas, to manage a packing house. In 1903 he moved to Redlands to take charge of the packing house of M. F. Whittier. Redlands has been his home and the growing and shipping of oranges his business ever since. He has a packing house of his own at Bryn Mawr and a holding of 225 acres of citrus.

Mr. Break firmly believes in the power of high production and fine quality fruit to bring profits in growing oranges. Therefore, he has always considered feeding trees generously from the standpoint of a high level of production rather than the minimum requirements of an orange tree for sur-

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Allen Break inspects a shipment of fruit in his packing house at Bryn Mawr, California.

Soil & Fertilizer Needs of Apple Orchards

By M. A. Blake and O. W. Davidson

Agricultural Experiment Station, New Brunswick, New Jersey

THE amount and quality of growth and the amount and quality of fruit produced by an apple tree are the result of the combined influences of all factors comprising the orchard environment. To produce large, well-developed trees with heavy crops of high-grade fruit is the ideal of the fruit grower. Under the most favorable environmental conditions for apples, it is not uncommon for the trees to attain a height and spread of 40 to 50 feet.

When apples are grown under favorable climatic conditions but on very fertile soils the trees tend to make a rank growth, are rather slow in coming into bearing, and are likely to produce fruits deficient in red color and edible quality. Where environmental conditions favor a moderately free growth, apple trees do not develop as large tops but tend to bear earlier and to produce fruits of better color and quality than under the previous set of conditions. When the moisture supply is deficient and the soil is shallow, or if the temperatures are relatively low apple trees tend to be dwarfed, flat-topped, and relatively low in production. When soil and moisture conditions are extremely unfavorable, apple trees lack vigor, and are unproductive and relatively short-lived.

The first fundamental information to be secured in the analysis of any orchard is the nature and classification of the environment. For the purpose of such an analysis the environments for commercial apple orchards may be classified as follows:

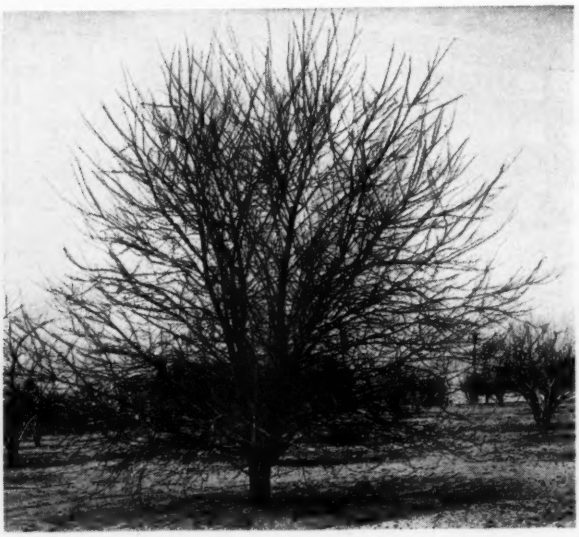

Fig. 1. An over-vegetative tree grown in environment 2.

1. *Excessively wet or poorly aerated soils.* Apple trees planted on soils having a high water table, or soils that are too dense and poorly aerated, may grow fairly well while they are small; but they remain shallow rooted. Such trees gradually become weak and die prematurely. In less severe cases the trees tend to be bushy, thin-twigged, produce a poor grade of

fruit, and are uncertain in production.

2. *Liberal moisture with rich soil and favorable climate.* Where the soil is moderately heavy to heavy, deep, moist, well-drained, and fertile, and the climate is favorable, apple trees tend to make a strong active growth and develop into very large trees which are late in bearing. Under these conditions apple trees tend to produce fruits somewhat deficient in red color and in edible quality. The trees easily become over-vegetative and are likely to develop an abundance of succulent water sprouts. This condition is especially apt to develop if the soil is clean tilled, excessively fertilized with nitrogen, or if the trees are pruned improperly.

3. *Well-aerated soils medium in fertility and in moisture supply.* Apple trees planted on light loam, gravelly loam, or sandy-loam soils not especially fertile, but providing an adequate but not excessive supply of water, tend to be moderately vegetative and fruitful. Such trees attain a medium to medium-large size, and the twigs and spurs tend to be thick in diameter. The trees usually come into bearing earlier and produce more consistent crops of better color, texture, and quality than trees grown in environments 1 or 2.

4. *Open sandy and gravelly soils.* Where apple trees are planted upon very porous soils that are definitely low in nutrients and in organic matter, but the moisture and climatic conditions are fairly favorable, growth tends to be rather slow and compact. Such trees are usually somewhat flat-topped and small. If the soil is not too poor, trees under such conditions tend to come into bearing early and produce highly colored fruits. The capacity of the trees is limited and hence the crops are relatively small. In general, these trees tend to become prematurely old and do not remain in good production so long as those in environments 2 and 3.

Where light soils are deficient in moisture supply, and climatic conditions are unfavorable, the young trees grow slowly and remain small and dwarfed.

Fig. 2. A portion of a productive tree grown in environment 3.

The twigs on such trees are thin and the leaves are small. Under these conditions apple trees reach a commercial production stage very slowly, if at all, are irregular in cropping, and yield small fruits. Heavy losses of trees and abandonment of the orchard usually result under these environmental conditions.

Environmental Factors

It should be evident that any system of soil management adopted in an orchard must be based upon the nature of the environment. Three environmental factors of fundamental concern in this respect are soil moisture, organic matter, and nutrients. A few examples of the relation of soil management to environment follow:

A grass sod tends to remove water from a soil and cause it to dry out. At the same time, a grass sod tends to utilize a large portion of the nitrogen available in the surface soil. The competition of the grass for moisture and nitrogen offers an effective means of controlling an over-vegetative type of tree growth. A sod or sod mulch system of soil management, therefore, is usually required for best results under

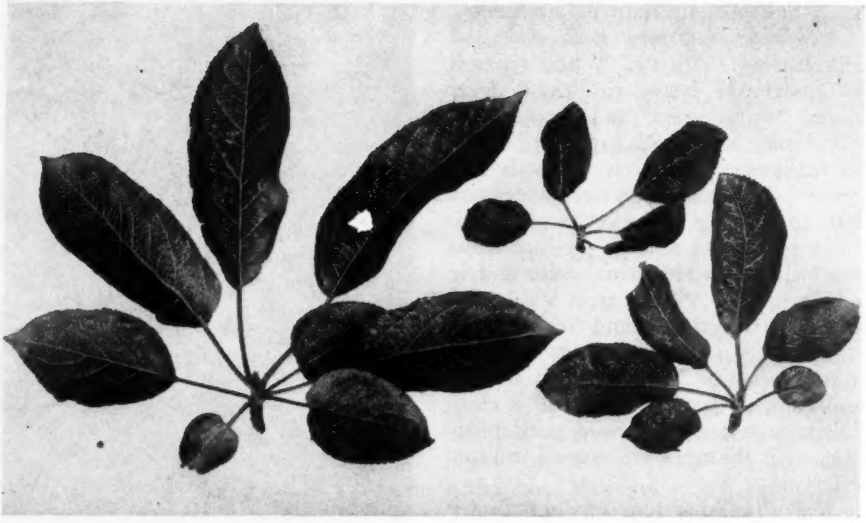

Fig. 3. Spurs of distinctly different growth status as indicated by their leaves.

conditions similar to those of environments 2 and 3.

Alfalfa or sweet clover sods with or without partial mulching with organic material, or alternate row tillage with these crops, are practices which offer less competition for moisture in the surface soil than grass sod. At the same time, alfalfa and sweet clover offer little competition with the tree for nitrogen. A system of soil management utilizing these crops is particularly applicable in environment 3. In some situations the system may be used in environment 4.

Clean cultivation tends to stimulate vegetative activity in the trees and favors rapid nutrification in the soil. In environments 3 and 4 where competition between trees and weeds for moisture and nitrogen may be serious in early summer, this practice is economical and desirable, provided that an adequate supply of soil organic matter can be maintained and soil erosion can be controlled. This method of management, however, tends to stimulate too much growth upon trees in environment 2.

It should be evident now that the nature of the environment and the system of soil management practiced are important factors to be considered in determining the fertilizer requirements of an orchard. Before specific conclusions concerning fertilizer requirements can be reached, however, it is necessary to determine the variety or varieties grown, the ages and sizes of trees, their growth status, and the fertility of the soil.

Varietal Characteristics

In order to judge what is good or poor, normal or abnormal growth of trees in an apple orchard, it is necessary that one know the characteristics of the variety or varieties grown. Some varieties produce only light crops under the best of conditions. Most varieties are somewhat individual in their requirements and, therefore, succeed best only when favored by certain combinations of environmental conditions. No one variety is grown commercially in all apple-growing regions. Thus, if the growing season is short and cool, as for example in New England, Winesap apples will be small regardless of the fertilizer treatment. In contrast, a variety like McIntosh or Baldwin fails to develop red color and good commercial quality where the summer temperatures are high, as in the southern apple-growing States. In a fertile, moist environ-

ment varieties such as Mammoth Black Twig, Baldwin, and Northern Spy are inclined to be over-vegetative and unfruitful, particularly in a warm climate. Under similar conditions Wealthy and Duchess may fruit well.

Varieties susceptible to fire blight should be managed with extreme care. They should not be allowed to become over-vegetative nor under-vegetative.

After the variety or varieties have been determined, the following facts need to be ascertained: 1. Are the trees of bearing age? 2. If of bearing age, are they fruiting well or poorly? 3. Are the trees over or under-vegetative? 4. Are they making a weak, good, or excessive growth? 5. What is the nature of the foliage as to size, shape, color, and condition?

In general, as apple trees increase in age, they increase in size and in productive capacity. This increase in size and yield is accompanied by a greater demand for plant nutrients. The nutrient requirements of a well-grown apple tree may increase considerably after it attains an age of 15 years. This is especially true of orchards planted somewhat too closely. In fact, where trees are too crowded, light and moisture may be limiting factors, and it may not be possible to attain the desired type of tree growth until some of the trees are removed. Rule-of-thumb methods for estimating the increase in nutrient demand solely on the basis of age or trunk diameter are to be discouraged.

Fruit production by an apple tree is not determined solely by the amount of growth it has made, but by the quality of the growth or the amounts and quality of reserve foods it has accumulated. Quality of growth is indicated in a general way by the fact that trees which develop a larger number of spurs with large buds are in a favorable condition for fruit production; trees which develop a large number of twigs and shoots, and few spurs, may be termed over-vegetative; and trees which make very weak growth and develop small, yellowish-green foliage are markedly under-vegetative. More accurate methods than this for judging the growth status of certain varieties of apples have been established by the New Jersey Experiment Station. One of these is a summer standard for Delicious.

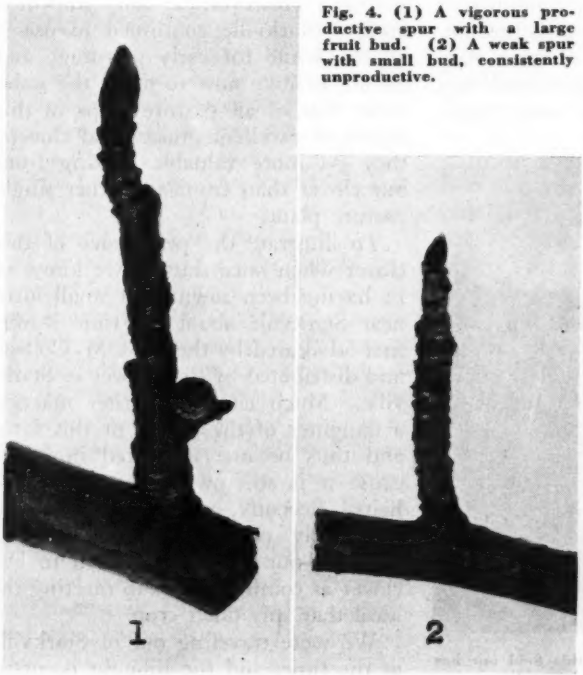

Fig. 4. (1) A vigorous productive spur with a large fruit bud. (2) A weak spur with small bud, consistently unproductive.

The application of this standard may be illustrated by figure 3. Spurs represented by the large one are almost certain to form medium-large or large buds which, under favorable conditions, will set fruit the following year. If a tree develops one or more large, well-developed spurs every 10 to 15 inches of fruiting wood, it is in a good growth status, and

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Bur Clover Is Good for Soils and Pasture

By E. B. Ferris

Superintendent, Holly Springs Branch Experiment Station, Holly Springs, Mississippi

THERE is nothing new about bur clover and its use as a soil-builder and pasture crop, especially in Mississippi. Some 50 years ago it was being advocated for both purposes in the region around Starkville and the A. & M. College, and for a number of years afterward the seed was sold in rather large quantities by growers in that territory. We recall a fine old gentleman in Starkville who, within the corporate limits of the town, produced and sold thousands of bushels of bur clover seed. He grew the crop primarily as a pasture plant, which, in combination with Bermuda grass, gave a pasture unsurpassed by any other mixture then known. Original seedings started then have persisted for all these many years, as the writer has found out by his recent intense interest in the crop.

Bur clover grows so thick in this field one has to grabble to find the ground.

But the State-wide interest in bur clover seemed to have waned and not to have been revived until within the past 10 years, when a few planters in the Mississippi Delta began to advocate its use purely as a soil-building crop to take the place of vetch, winter peas, and crimson clover. This was largely because of the better seeding qualities of bur clover and the fact that when once a field was thoroughly seeded, the necessity for annual planting was eliminated. However, a few stockmen around Starkville continued to use it all the while for early pasturage and do not hesitate now to make the statement that of all pasture crops in this region of excellent grasses and clovers, they get more valuable grazing from bur clover than from any other single pasture plant.

To illustrate the persistency of this clover when once started, we know of its having been sown on a small farm near Starkville about the time it was first advocated by the A. & M. College and distributed by the grower in Starkville. Much later the writer married a daughter of the owner of this farm and thus became interested in it because it is still owned jointly by the heirs. Recently, in seeking a combination early pasture and soil-building crop for our farm, we turned to bur clover as coming nearer to meeting the ideal than any other crop.

We were traveling out of Starkville at the time, and the thought occurred

Overlooking fields of vetch and bur clover on the Ferris plantation, Vicksburg, Mississippi.

that some bur clover seed might be had from the pasture on this Starkville farm. Rather to our surprise, it still flourished and, although many work animals and dairy cattle had been continuously grazed on a small acreage and the farm entirely tenanted by negroes for 50 years, this clover still furnished one of the best early pastures seen around Starkville and had grown so rank at the time that in the richer places it stood between knee and waist high. It only remained then to contract with this tenant to save some seed, a thing he had never done.

This was done by agreeing to pay the customary wage scale for women and children, $1.00 a day for the tenant himself, and 10 per cent of the cost of all labor for his supervision over it. During the course of 3 years we saved 2,800 bushels of seed in bur and could have saved many more if they had been needed. This was done in the crudest way, by the use of hand rakes for removing the dead stalks and wire brooms for sweeping the seed from the ground. The cost was a little under 3 cents per bushel in bulk, and the added expense of buying sacks, bagging, and delivery some 200 miles away still kept it under 10 cents per bushel.

The trouble in getting bur clover started in the past has been the difficulty in securing stands and the cost of buying seed at the prevailing price of about $1.00 per bushel. Even where 10 bushels of seed are planted per acre, one seldom gets a perfect stand the first year. This is caused by the slowness with which the burs themselves disintegrate, thus allowing the seed to come in intimate contact with the soil; also because of the hardness of many of these seed, which without scarifying, will lie dormant in the soil for several years before germinating. The difficulty of getting stands of bur clover has caused the agronomists to do a lot of work in the past, dipping them for certain lengths of time in boiling water to soften the coats, a practice that worked well in a small way, but proved too much trouble for the large grower.

Slow Germination Favorable

In recent years it has developed that this difficulty of getting all bur clover seed to germinate in a single year is really in its favor. When plenty of seed are left on the ground, even a small percentage of them germinating in a single year will give a stand, leav-

ing enough ungerminated to continue to give stands for several years. Thus in the Mississippi Delta where the crop is now being grown on tens of thousands of acres, they are finding it possible, when once a thorough stand is obtained, to plow under the crop before seeding for as many as 4 or 5 years and continue to get stands each year from seed left ungerminated from the original sowing.

Eliminates Fall Plowing

This eliminates the necessity of plowing the land in the fall as when planting other winter legumes; practically insures a stand of clover as early as it is possible to get and maintain one; and is really an important factor in erosion control, because there is much less loss of fertility on unplowed than on plowed land, especially where, without breaking in the fall, one gets a good stand of a close-growing, winter cover crop. It has been found from actual experience that there is much less erosion on lands covered with bur clover than on similar ones growing vetch or winter peas, because the habit of growth of this bur clover makes it partake more of the nature of a sod crop and also because one does not start out in the winter with freshly plowed land.

There are many varieties of bur clover, the most common ones being California bur, Southern or spotted bur, Manganese bur, and the more recently developed Giant bur which seems to be identical with Southern bur except that it matures its seed some 2 or 3 weeks earlier and is, therefore, more valuable when grown purely as a soil builder and in rotation with summer crops, such as corn and cotton. As a pasture crop Giant bur is not believed to be any better, if as good as the Southern bur, because it dies earlier and possibly does not begin to furnish grazing any sooner.

While animals have to acquire a taste for bur clover and prefer most any other pasture crop to it, this clover grows so much earlier than any other that for weeks during the winter animals get good grazing, whereas without it they would get none at all. Thus on some 60 acres of bur clover pasture on our own farm, large numbers of cattle, horses, hogs, and sheep were largely supported this year from the middle of January through March, and with all but continuous grazing during the time, this clover stood knee-high at the end of March.

Bur clover seems a little more selec-

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This picture shows beef heifers grazing in a field of bur clover in March.

That's What They Call 'em

By Barbara Worrell

Weed Investigations, Bureau of Plant Industry, United States Department of Agriculture

YOU know, we do an awful lot of talking. As mankind goes plodding down the corridors of time, he fills the air with so many words that they drift in currents and little channels of repetition, and collect gradually about objects or ideas until in every language each set of ideas or occupations has its own little drift of words that grows with time or is snowed under and lost in the great blizzard of words that makes up a language. As man admires pleasant things and complains about traffic, head colds, mosquitoes, and weeds, he unconsciously builds for each of them a vocabulary of its own.

My work happens to deal with weeds, and every day there go across my desk some of the thousands of strange names by which weeds are known in various parts of the world. Thanks to that hard-working Swede, Linnaeus, and his followers every plant has, of course, its proper Latin name, but who bothers with a name he can't even pronounce? So you and I, and the farmers in Minnesota, South Africa, and Siberia, know the plants on our own domains by the names our fathers called them, or our neighbors and our neighbors' fathers.

My favorite weed at the moment is "herbe a mal d'estomac," an uncommon plant which, unless my French is going back on me again, must have made someone uncommonly sick around 1891. Or did it cure him? I'll never know.

Another thing that puzzles me is why farmers in one county swear at creeping Charlie, while the same plant a few miles away skulks along as creeping Jennie.

Some names have clung, like warning signs, to certain weeds: tread softly, sneezeweed, children's bane, rip-gut grass, death camas, death-of-man.

From All Sources

Religion seems to have left its mark where gardeners hoed and farmers plowed, for there are Job's tears, monk's head, priest's crown, St. John's blood, sweet life everlasting, blessed thistle, Our Lady's thistle, and Star-of-Bethlehem—as well as holy roller. Of course there are, on the other hand, cursed thistle, devil's grandmother, devil's plague, devil's claw, and devil's paintbrush; and, while we're speaking in plain words: bunk, malo mujer, hell weed, blaw-weary, and stinking Willie. Stinking Willie has cousins named Poor John, Salvation Jane, and Jack-by-the-hedge.

Apparently poets have weeded gardens too, and of course they uprooted gold-of-pleasure, moon-penny, silvery cinquefoil, doon-head clock, lalang, and silken cissy.

In Australia and South Africa the weeds must be downright cute. How would you like to wake up some drizzly Monday morning to find your garden all overrun with bidgee-widgee, bidi-bidi, roley-poley, or bindi-eye? Then, too, you'd have to watch out for piri-piri, uintjies, sprinkaanbos, and dubbeltjie doring.

On the whole, I think I'll stick to

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Boron Deficiency Becomes a Problem In Michigan

By R. L. Cook

Michigan State College, East Lansing, Michigan

THE possible deficiency of Michigan soils in nutrient elements other than those usually applied in commercial fertilizers has been under study for several years. These studies have indicated a deficiency of boron for certain crops on a number of soil types. A lack of boron in the soil is evidenced by certain characteristic plant symptoms, by rate of growth, and by date of maturity. In this article are presented descriptions and photographs of boron deficiency symptoms on various crops, and some results of the effect of borax on the yields of certain leguminous plants. A discussion concerning the general need of Michigan soils for applied boron is also included.

As a result of the findings of Kotila and Coons, the attention of the Soils Section of the Michigan Experiment Station was recently called to a certain disease of sugar beets known as heart rot. For several years attempts were made by European investigators to trace the cause of this disorder to some organism, but it was finally shown by Brandenburg and later by others that the injury was due to a deficiency of boron in the soil. Vilkaitis reduced heart rot infection from 51.7 to 4.4 per cent by the application in water solution of 5 kgm. of borax per hectare. Further reductions of 1.2 and 0.5 per cent were obtained by 10 and 20 kgm. applications respectively. Brandenburg reported complete prevention of heart rot in pot tests as a result of additions of 30 to 50 mg. of boric acid per plant, and similar results in the field as a result of the application of 20-25 kgm. of boric acid per hectare. He stated further that the beneficial effects persisted the year after the application. Kotila and Coons obtained the most vigorous growth of beet plants in quartz cultures as a result of the applications of 20 pounds of borax per acre. They reported also the recovery of sugar beets inflicted with heart rot as a result of placing them in soil treated with borax.

Field Plat Experiments

As a result of inquiries regarding the addition of borax to sugar beet fertilizers in Michigan, a small amount of field plat work on this problem was conducted by the Michigan Station in 1936. Experiments were completed on five farms in Gratiot and Tuscola Counties, but unfortunately the experiments were located on fields where the deficiency symptoms did not occur.

In the fall of 1936 a survey of certain of the sugar beet areas showed the presence of serious heart-rot injury in the northwestern part of Tuscola County, near Wisner, Unionville, and Akron, and in the southwestern part of Huron County, near Sebewaing. Arrangements were made at that time for 1937 field plats in those areas.

The 1937 investigations were so planned as to give information regarding the quantity of borax necessary to control heart rot and the quantity which might be added without injury to the sugar beet crop and to following crops. Again, as in 1936, the injury did not occur on the fields where the experiments were located. This was in spite of the fact that it had occurred on adjoining fields in 1936 and was found in many other portions of the sugar beet area in 1937. The experiments, however, resulted in one interesting observation. The highest application, 80 pounds of borax per acre, made broadcast before planting, was not injurious to sugar beets on either

Fig. 1. A darkened and cross checked leaf petiole is indicative of boron deficiency in sugar beets.

Wauseon sandy loam or Nappanee silt loam. This may have been influenced by the fact that moisture conditions were ideal on both fields at planting time and there was no serious deficiency of moisture at any time during the season.

During the 1937 season no fields were observed where boron deficiency injury was as serious as it was on certain fields in 1936, but a survey during the harvest season showed deficiency symptoms to be definitely present in 15 out of 36 fields. Of the 21 fields not definitely classed as bearing deficiency symptoms, several were classed as being suspicious. While the survey was not sufficiently detailed to completely classify infected areas throughout the

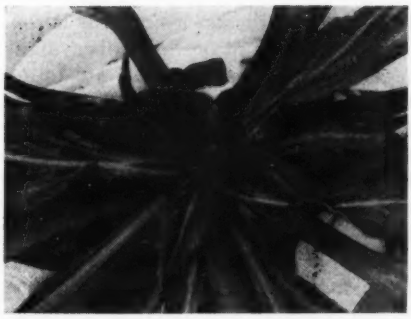

Fig. 2. Shortened petioles and twisted leaves suggest boron deficiency in sugar beets.

beet-growing region inspected, indications were that boron deficiency occurs in localized areas. It was found to be especially prevalent in the vicinities of Cass City, St. Louis, Mt. Pleasant, and Maple Rapids. More restricted appearances were noted around St. Johns and Unionville. An interesting observation made previously by Kotila was borne out in this survey. Wherever the deficiency was noted on rolling or hilly fields, it always occurred on the higher soils.

During a survey of a portion of Michigan's sugar-beet-growing area in the fall of 1937, many of the characteristic boron deficiency symptoms described by Brandenburg and Kotila and Coons were observed. As illustrated by figure 1, a darkened and cross-checked leaf petiole is indicative of boron deficiency. Likewise, a shortened petiole and twisted leaf, as shown

Fig. 3. Some sugar beets, seriously inflicted with heart rot, fail to put forth the new fall growth of leaves.

in figure 2, indicates a need for boron.

In late August or September many beets on boron-deficient soil are found to have an entirely dead heart. As the new fall growth of leaves comes on, these beets may fail to put forth new leaves or the new growth may be sufficient to entirely cover up the dead heart. Figure 3 illustrates the appearance of a beet which failed to put forth new fall growth.

Side cankers and internal discolorations are also characteristic symptoms of this disorder. The whole beet shown in figure 4 gives an idea of the appearance of the cankers, while the cut sections illustrate the discolorations. In some cases the discolorations extend to the surface, while in other cases they can only be detected by slicing the beet.

Disease Scattered

In some fields where the deficiency was not serious, injured beets were found scattered among healthy beets, while in many cases whole patches were affected. Such a patch, as it existed on a farm near Mt. Pleasant, is shown in figure 5.

As might be expected, all of the deficiency symptoms were not always found in the same field. In some fields only leaf symptoms were apparent, while in others the presence of cankers or dead hearts furnished the clue that a boron deficiency existed. In most cases beets with dead hearts showed cankers and discolorations as well.

Further work in this laboratory, the results of which will be published later, has shown definitely that the described symptoms were actually indicative of boron deficiency. This was accomplished by splitting the injured beets and planting the halves in quartz cultures with and without boron. Shoots from halves which received boron made a more rapid growth than those from corresponding halves without boron and did not put forth leaves showing the characteristic deficiency symptoms. The untreated halves, on the other hand, all produced leaves with the same symptoms noted in the field, except in one case in which the untreated half failed to grow. The differences in growth between the treated and untreated halves of three beets are shown in figure 6.

Attempts have been made by various investigators to correlate boron deficiency with certain soil conditions. In experiments with Washington Navel Orange trees, Haas found that when high concentrations of calcium were used in solutions supplied to sand cultures, it was necessary to increase the concentration of boron to prevent boron deficiency symptoms. Solunskaya ex-

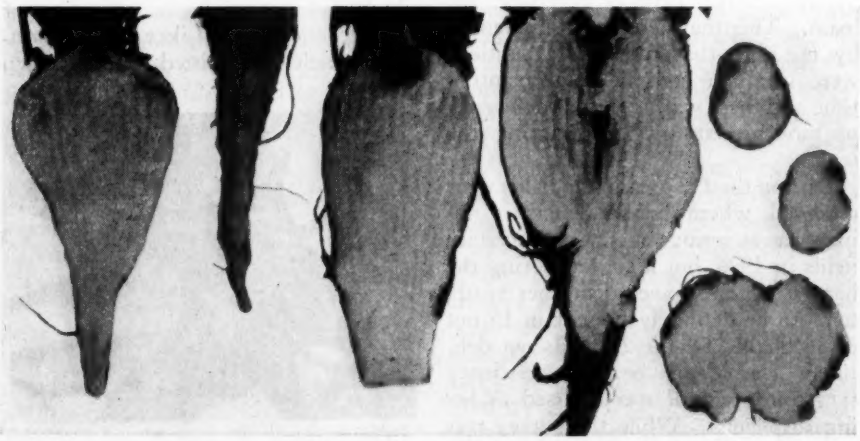

Fig. 4. As shown by the whole beet, boron deficiency symptoms may occur as cankers or, as indicated by the cut sections, as deformities in the heart and as discolorations beneath the surface of the beet.

plained the more serious infestation in sugar beets on alkaline soils as being due to the greater top growth and the corresponding greater need for boron, rather than to the fact that boron is not readily available in alkaline soils. Also working with sugar beets, Fron reported a pH of 8.0-8.5 for most of the soils where boron deficiency injury was encountered. He also reported the greatest injury on soils where the moisture content was low. Brandenburg reported that heart rot occurred on acid as well as on alkaline soils. Willis and Piland reported three cases of a definite response to borax, one with alfalfa and two with romaine. All three occurrences were on liberally limed soil.

Fig. 5. Heart rot of sugar beets occurs in patches. On Oct. 14 some of the beets in this patch were completely devoid of green leaves while some had put forth considerable new fall growth.

Experimental. In the 1937 survey mentioned above, soil samples were taken in numerous fields. An attempt was made to correlate boron deficiency, as indicated by the plants, with some condition in the soil, either reaction or boron content. As deficiency symptoms were more commonly found on Miami soils than on any other single soil series, the laboratory experiments to date have been confined to the Miami soils.

Of 24 samples obtained from this soil, 16 were from soils on which the beets showed boron deficiency, while 8 were from fields free of deficiency symptoms. Of the 16 apparently boron-deficient soils, 14 ranged in pH from 7.1 to 7.9. From this data it would seem that boron deficiency is more likely to occur on alkaline than on acid soils. When the other eight samples are considered, however, a doubt is cast on this relationship. Of the eight samples taken from areas where boron deficiency did not occur, five were alkaline with a pH from 7.0 to 7.4.

In the fall of 1936 the writer decided to undertake certain experiments which might reveal the effect of boron deficiency on other commonly grown Michigan crops. It was hoped that a knowledge of boron deficiency symptoms on several crops would make it comparatively easy to spot boron deficient soils and thus simplify the problem of making the proper borax recommendations for sugar beets.

Alfalfa, barley, beans, corn, sweet clover, red clover, and alsike clover were grown in a greenhouse in 1-gallon glazed earthenware jars, each filled with 5 kgm. of white quartz sand. Nutrient mixtures and rates of application were exactly as described by Muckenhirn of the University of Wisconsin in his boron experiments with lettuce, except that sodium tetraborate was used in place of boric acid, and the nutrients were added in four separate applications. Two additional applications of the soluble nutrients were made in the case of alfalfa. By frequent weighings the moisture content of the sand was maintained at 10 per cent. Treatments were replicated four times.

Alfalfa and alsike clover were also grown in glazed earthenware jars filled with soils from fields where previous crops had shown signs of boron deficiency. The alfalfa was treated with $Na_2B_4O_7$* at the rate of 2 pounds per acre, and the alsike clover received 3 pounds of the same material. Treated and untreated cultures were set up in replicates of four. All cultures received complete nutrients other than boron.

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* Similar to ordinary borax.

Sullivan Farmers Test Their Soil

By H. N. Wells

County Agent, Sullivan County, Claremont, New Hampshire

SUPERVISORS under the Soil Conservation Program, who last spring visited farmers of Sullivan County, New Hampshire, helping them to plan their crops, took a decided interest in soil testing. The farmers wanted a test that would show soil conditions not only as to need of lime, but also need for plant foods such as nitrogen, phosphoric acid, potash, and magnesium. They also wanted to know whether there was a toxic condition because of an over-supply of aluminum. The last-named element always arouses interest, and some farmers wonder if they had better go to mining it. However, it is a deterrent rather than a help if it exists in relatively large amounts, for it creates a toxic condition under which most farm crops grow poorly or not at all. This is especially true of clovers. This condition may be easily corrected by an application of lime.

Wide-spread Need for Lime

Last year the soils from 351 fields in Sullivan County were analyzed and detailed reports were made to the farmers. Of these, 211 or about 60 per cent were found too low on lime to grow clovers readily. This was found more true on the upland soils outside the Connecticut Valley. In the valley region, especially near the river, the test showed sufficient lime, but even there, applications in some instances seemed to help the clover crop. There were 41 fields so high in lime that alfalfa could be grown readily if other conditions were right, such as ample plant food, Grimm seed inoculated, and a good seed bed.

The tests also showed a decided deficiency in phosphorus and potash. Crops and animals use large quantities of both and they must be added to the soil in some way. While a few had just a trace, 277 fields or 78 per cent were found to be low or very low on phosphorus.

Other Deficiencies Disclosed

Of the fields tested, 65 per cent were far too low in potash to grow good crops, especially legumes, 148 fields had no potash at all, and 90 others had just a trace.

The fields found very low on ammonium nitrogen totaled 207, and 94 had either no nitrate nitrogen or just a trace. There were 246 fields either very low on or with just a trace of magnesium, a condition readily corrected by the application of lime.

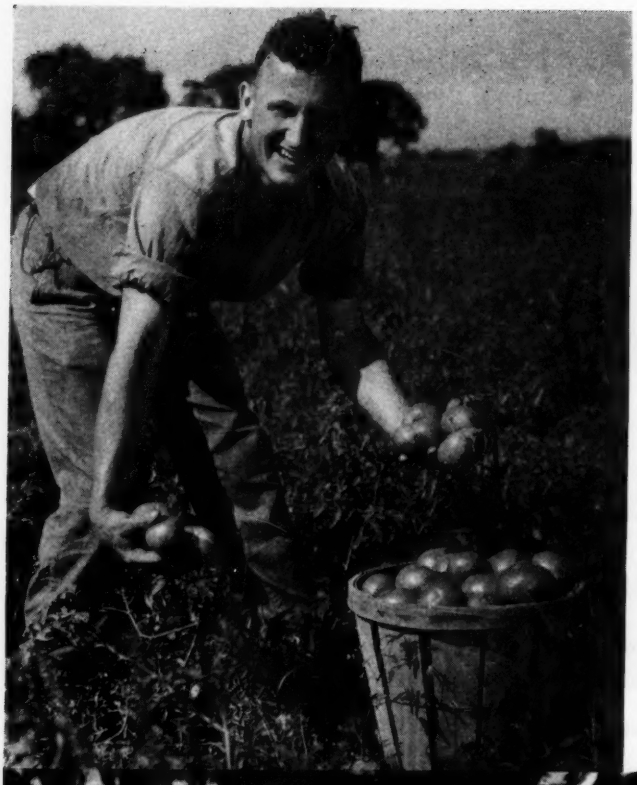
These deficiencies, coupled with a very high aluminum content on nearly one-half the fields tested, probably explain why many farmers do not get the yields they should. They also indicate a lot more soil testing for farmers who want to know. With a generous government payment for lime, superphosphate, and potash, farmers are encouraged to build up the productivity of their soils as never before. Despite the unusually wet spring last year, they applied more than 41,000 pounds of available potash, more than 70,000 pounds of available phosphoric acid, and 798 tons of lime.

PICTORIAL

Enjoying their breathing spell.

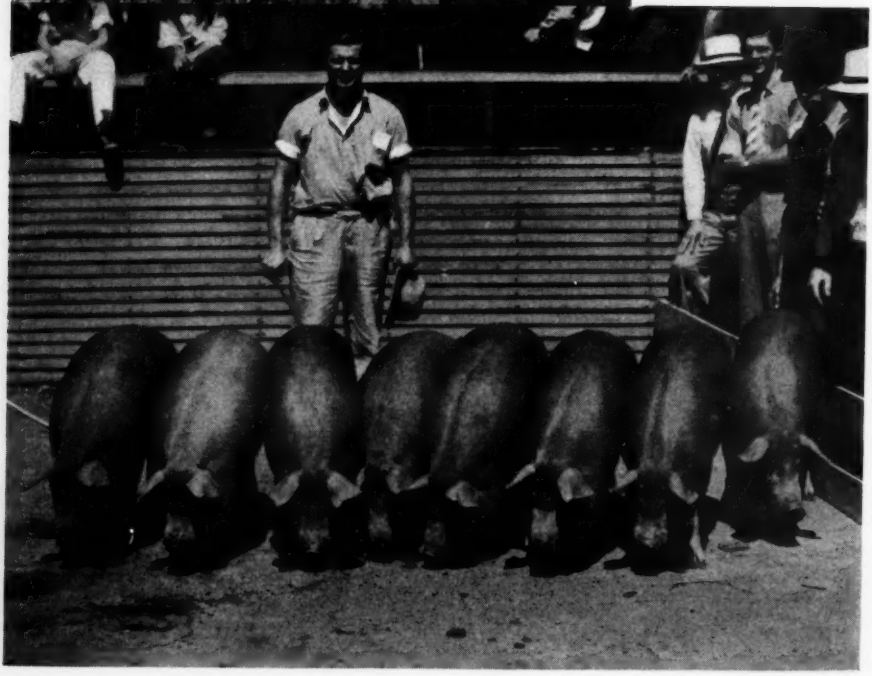
To each section the bounty of the harvest season has its own significance.

North and South, harvest landscapes pay tribute to man's-effort to achieve.



David Snyder of Franklin, Indiana, is the State's 1938 champion tomato picker. He also has been three times winner of his local corn-husking contest.

Maurice Lux, son of Indiana's well-known Corn King—Peter J. Lux of Shelbyville, won first prize at Indiana's 1938 Ton Litter Show.



The Editors Talk

Stabilized Crop Yields

Within recent years yields of several of our important crops have fluctuated widely, resulting in some years in large surpluses and in other years in such great deficiencies as to necessitate a considerable volume of imports. These conditions were naturally accompanied by great fluctuations in prices consumers had to pay and in income of the farmer and a violent disruption to what may be termed the general agricultural rhythm of the country. To those who are earnestly working for the planned stabilization of agriculture it has been a trying and disheartening period.

With the advent of crop insurance, problems of variation in yield are receiving increased attention. While insurance may reduce the effects of the variation on the individual by spreading them over many farmers, the problem as a whole is as important as ever. To those charged with the administration of the crop insurance plan the problem is an acute one, involving as it does the degree of risk, premium, necessary reserve, and other actuarial factors.

We already have had very forcibly brought to our attention the fact that while acreage of crops may be fairly well controlled this alone will not necessarily eliminate the possibilities of over or under production. Any practicable means of reducing these yield variations per acre will therefore be of interest and importance to our agriculture in all its aspects. A significant contribution to the stabilization of acre yields of crops is made by L. D. Miller and F. C. Bauer of the Illinois agricultural experiment station in their article in the August 1938 issue of the Journal of the American Society of Agronomy.

Using data accumulated over a period of years on the 17 soil experimental fields located in representative areas of the State, the authors studied the effects of various soils and management practices on variability in corn yields from year to year. This study revealed that the dark, more fertile soils produced corn with less variability than the less fertile soils. The use of adapted fertilizers and manure greatly reduced variability in yield on the less fertile soils. The most effective treatments differed on the various fields, but in most cases manure, lime, and phosphate reduced variability. On a number of fields, crop residues, lime, phosphate, and potash also were very effective. An interesting point is that while most uniform yields were usually associated with high yield levels, they were not always correlated with the highest yield.

It thus is evident that while seasonal variations cannot be entirely eliminated, corn yields can be stabilized to a much greater extent if good fertilizer and soil management practices are followed than if no or improper treatments are given. As the authors point out: "Good soil and good farming methods are in themselves very good corn crop insurance under Illinois conditions. Farmers who practice good farming methods will have few seasons of extreme surplus yields and are in a good position to predict the amount of their corn production." Such good

practices fit in very well with the soil conservation program of the Government and certainly must form an important link in the program of stabilized production and supply of crops.

Dr. Hugo Neubauer

Agriculturists, scientific organizations, and periodicals in many parts of the world recently have been giving well-deserved tribute to Dr. Hugo Neubauer, professor and retired director of the Saxon Agricultural Experiment Station in Dresden. The occasion was his 70th birthday on September 2, and the tributes were for his outstanding contributions to world agriculture.

It is very fitting that these many tributes should be paid to Dr. Neubauer, who is best known in most countries for his development of the plant seedling method for determining available nutrients in the soil. This seedling method, which bears his name, alone would insure his place in the field of agricultural research. Added to this is a considerable volume of work on animal and plant nutrition and general analytical chemistry, attesting to the broadness of his interests.

Dr. Neubauer first published information on his seedling method in 1923, and within a short time it was being used in many countries. For years agricultural chemists had been trying to determine the availability of nutrients in soils, and from this their fertilizer requirements. The problem had always been to find a chemical solution that would dissolve the nutrients out of the soil to the extent that they were available to the plants. Some investigators had devised solutions they thought were quite satisfactory, while others despaired of ever attaining the goal and believed only laborious and time-consuming field experiments could be used with certainty.

Since it was difficult, if not impossible, to prepare a proper extracting solution, Neubauer used the plant itself to extract the available nutrients from the soil. For this purpose he employed young rye seedlings growing under carefully controlled conditions, analyzing them chemically to see how much nutrient they absorbed from the soil. By the use of several pounds of soil and with proper treatments, it is possible by this method to carry through to completion within a month in the laboratory an experiment that would take a year to do in the field, even with favorable weather conditions.

The Neubauer method has been of inestimable value in fertilizer and soil research and is being used in ever-increasing volume in this country and Canada. Purdue University was one of the first institutions to try it, and experiment stations in Wisconsin, Ohio, Vermont, Michigan, California, Tennessee, Oregon, Washington, Ontario, and other places have done considerable work with the method. Undoubtedly it has been a factor in the development of the rapid chemical tests for determining the fertilizer needs of soil that recently have become so popular and useful. The short methods usually are correlated against Neubauer results as well as field results in order to save time.

Dr. Neubauer is respected as a scientist by all who know his work. By those fortunate enough to know him personally he is respected, admired, and esteemed as a man. His kindly personality and fine but unassuming character make an indelible impression on all who come in contact with him. We extend to Dr. Neubauer our best wishes and fervently hope we may be favored with his work, advice, and influence for many years to come.

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture and the State Experiment Stations relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizer

¶ The movement to lower the cost of commercial fertilizer by reducing the large number of grades manufacturers are compelled to stock under present demands is receiving added impetus by agricultural leaders of the Federal and State institutions. New Jersey Agricultural Experiment Station Circular 375, "Farmers Can Reduce Fertilizer Cost," by A. W. Blair, is very appropriate in this connection, in that it shows in simple terms how the fertilizer industry, experiment station, growers, and county agents can cooperate in reducing the number of grades and thereby save farmers many thousands of dollars.

To stock a multitude of fertilizer grades naturally means the farmer must pay the additional cost of handling, stocking specially printed bags, and support of additional State control work. Professor Blair states that "it would be well for us to face the facts and admit there is little to be gained in laying stress on fine distinctions in grades. Rather we should lay stress on the proportions of the elements (ratios) and on the amount of nutrients applied to the acre. Many grades could be eliminated because they are very rarely used. . . . Frequently one grade could be eliminated by using a little smaller amount of a slightly higher grade having the same ratio." Certainly the points given in this circular are in the right direction to help the farmer to save on his fertilizer bill.

¶ Since 1929 Dr. V. H. Young and his associates of the Arkansas Agricultural Experiment Station have devoted considerable attention to the control of cotton wilt and "rust" on potash-deficient soils in eastern and central Arkansas. Reports of their earlier studies have been made in several previous well-known publications. In his latest publication bearing on this work, "Control of Cotton Wilt and Rust, or Potash Hunger, by the Use of Potash-containing Fertilizers," Station Bulletin 358, Dr. Young presents a complete summary of these studies based on the data obtained from 1929 to 1937 at 15 different sites where cotton wilt commonly occurs.

According to these results, fertilizers containing potash gave control of rust and reduced the incidence of cotton wilt every year and at each location, except two. Heavier applications of potash were generally more efficient than low amounts in the control of wilt. Excessively high amounts of potash were, however, without correspondingly greater results. Furthermore, potash hunger, or rust was associated with cotton wilt at all but one of the experiments, the wilt here having been due to a severe attack of nematode disease. The data given and explained in the bulletin apply only to the wilt of ordinary upland cotton caused by *Fusarium vasinfectum* Atk.

Even though potash when applied alone frequently gave as good or even better results in cotton-wilt control than the same amount of potash in a mixed fertilizer, the latter usually resulted in better yields. The use of fertilizers lacking potash increased the intensity of rust and wilt on cotton growing on these soils. The author expresses the belief that field studies over a period of

years in practically every section where cotton wilt is a factor are necessary to determine just what combinations of cotton varieties and fertilizer analyses will provide the most satisfactory control of cotton rust and the reduction of wilt.

"Fertilizer Problems and Analysis of Soils in California," Agr. Exp. Sta., Berkeley, Calif., Cir. 317, Revised Apr. 1938, D. R. Hoagland.

"Purchasing Lime and Fertilizer," Agr. Ext. Serv., Durham, N. H., Ext. Cir. 210, Mar. 1938, Jay L. Haddock.

"Recommendations with Reference to the Fertilization of Flue-cured, Sun-cured, and Shipping Tobacco Grown on Average Soils in Virginia, North Carolina, South Carolina, Georgia, and Florida for the Year 1939," Agr. Ext. Serv., Oxford, N. C., July 21, 1938.

Soils

¶ The United States Department of Agriculture's 1938 Yearbook of Agriculture, "Soils and Men," probably may be labeled the most complete and thorough volume of facts and interpretations ever published, insofar as the innumerable elements centering around our soil problems are concerned. The outstanding contributions of more than 100 authors who collaborated in bringing out the present status of soil research make this a valuable and almost indispensable publication to those concerned with the soil of the country. This yearbook is one of a series designed to promote common understanding of modern agriculture from the scientific, practical, social, and economic aspects.

The subject matter is divided into five sections. Part 1, under the heading of "The Nation and the Soil," has to do with the problems and causes of soil misuse from the economic and social aspect, with possible remedies. Part 2, "The Farmer and the Soil," deals with a wide range of soil-management practices that may be applied by individual farmers. This is the longest single section of the yearbook, because it covers such a wide and varied field. Among the many subjects taken up here are the deficiencies of soil organic matter, nitrogen, phosphorus, and potassium, the authors prescribing general measures as to how these deficiencies may be corrected. Several articles giving an account of modern methods of determining fertilizer needs, fertilizing and liming, tillage, and erosion control are also included in this section.

Part 3, "Soil and Plant Relationships," is concerned with the soil requirements of plants and some relations between soil and plant composition. A chapter is devoted to the less common plant-food elements, such as magnesium, boron, iron, etc. Part 4, "Fundamentals of Soil Science," discusses the physical, chemical, and biological nature of the soil, which furnishes the scientific background for dealing with practical problems. Part 5, "Soils of the United States," describes the soils of the nation, including the territories, based on the work of the Soil Survey Division. Inside the back cover is a map distinguishing the soils of the country.

The present yearbook is a worthy companion to the last several volumes, each dealing very completely with a phase of agriculture. These books are a distinct contribution to our agricultural literature and reflect great credit to those responsible for their conception and preparation.

¶ Information of practical value to tobacco growers is detailed in Kentucky Agricultural Experiment Station Bulletin 379 entitled, "Soil Management and Fertilization for Tobacco," by George Roberts, E. J. Kinney, and J. F. Freeman. The authors explain that the soil for tobacco should be productive and well-drained. High yields can usually be produced by applying large amounts of commercial fertilizer, even on thin land, but good quality tobacco is seldom produced unless the soil is productive.

Burley grown on good sod land usually responds profitably to the use of 300 or 400 pounds per acre of fertilizer analyzing 4-5 per cent nitrogen, 8-12 per cent phosphoric acid, and 6-8 per cent potash. For the less productive soils, 500 to 800 pounds of fertilizer may be used profitably. Fertilizers for

the Burley type should be applied at the row.

A 3-8-6 or similar analysis applied at the rate of 200 to 300 pounds per acre is recommended for dark tobacco. The fertilizer for this type of tobacco should be used at the hills. On less productive soils, the complete fertilizer may be supplemented with a broadcast application of 200 pounds of superphosphate and 50 to 75 pounds per acre of either muriate or sulphate of potash. It is highly important that the fertilizer be placed in a manner so that the roots of the plants will not come in direct contact with it to prevent killing of the plants. Manure along with fertilizers gives very good quality tobacco of the types under discussion. Recommendations regarding the grasses and legumes for tobacco rotations, as well as many other soil management suggestions, are given in the bulletin.

"Studies on Soil Structure: Effect of Puddled Soils on Plant Growth," Agr. Exp. Sta., Tucson, Ariz., Tech. Bull. 72, June 15, 1938, W. T. McGeorge and J. F. Breazeale.

"Vermilion County Soils," Agr. Exp. Sta., Urbana, Ill., Soil Rpt. 62, June 1938, Herman Wascher, R. S. Smith, and L. H. Smith.

"St. Clair County Soils," Agr. Exp. Sta., Urbana, Ill., Soil Rpt. 63, June 1938, Guy D. Smith and L. H. Smith.

"Germination of Seeds and Damping-off and Growth of Seedlings of Ornamental Plants as Affected by Soil Treatments," Agr. Exp. Sta., Amherst, Mass., Bull. 351, May 1938, William L. Doran.

"Obtaining Soil Samples for Rapid Soil Tests," Agr. Exp. Sta., New Brunswick, N. J., Cir. 376, May 1938, Donald M. Goss.

"Liming Ohio Soils," Agr. Ext. Serv., Columbus, Ohio, No. 177, May 1938, Earl Jones.

"Distribution of Legume Bacteria in the Piedmont Soils of South Carolina," Agr. Exp. Sta., Clemson, S. C., Bul. 314, June 1938, T. C. Peele and J. K. Wilson.

"Soils of Texas," Agr. Exp. Sta., College Station, Tex., 522 Prog. Rpt., June 3, 1938, W. T. Carter.

"Soil Survey of Dallas County, Alabama," U. S. D. A., Washington, D. C., Series 1932, No. 22, April 1938, W. J. Moran, W. E. Tharp, W. J. Leighty, A. L. Gray, L. G. Brackeen, M. E. Stephens, and M. E. Swann.

"Soil Survey of Wilcox County, Alabama," U. S. D. A., Washington, D. C., Series 1932, No. 26, May 1938, G. A. Swenson, M. J. Edwards, B. H. Williams, A. L. Gray, W. J. Leighty, M. E. Stephens, M. C. Croft, and L. G. Brackeen.

"Soil Survey of the Upper Gila Valley Area, Arizona," U. S. D. A., Washington, D. C., Series 1933, No. 15, Feb. 1938, E. N. Poulson and F. O. Youngs.

"Soil Survey of the Napa Area, California," U. S. D. A., Washington, D. C., Series 1933, No. 13, Jan. 1938, E. J. Carpenter and Stanley W. Cosby.

"Soil Survey of Pike County, Indiana," U. S. D. A., Washington, D. C., Series 1930, No. 47, Jan. 1938, H. P. Ulrich, T. M. Bushnell, D. R. Kunkel, J. T. Miller, and E. G. Fitzpatrick.

"Soil Survey of Franklin County, Iowa," U. S. D. A., Washington, D. C., Series 1932, No. 23, Jan. 1938, T. H. Benton and F. R. Lesh.

"Soil Survey of Kingman County, Kansas," U. S. D. A., Washington, D. C., Series 1932, No. 24, Jan. 1938, E. W. Knobel, R. O. Lewis, and C. E. Dornberger.

"Soil Survey of Oceana County, Michigan," U. S. D. A., Washington, D. C., Series 1933, No. 12, Jan. 1938, C. H. Wonser, J. O. Veatch, and L. R. Jones.

"Soil Survey of Marion County, Mississippi," U. S. D. A., Washington, D. C., Series 1934, No. 6, May 1938, J. W. Moon, Clarence Lounsbury, Robert Wildermuth, C. S. Simmons, Arthur E. Taylor, and Z. C. Foster.

"Soil Survey of Loup County, Nebraska," U. S. D. A., Washington, D. C., Series 1934, No. 1, Nov. 1937, Basil Abaskin and F. A. Hayes.

"Soil Survey of Garfield County, Nebraska," U. S. D. A., Washington, D. C., Series 1934, No. 3, Feb. 1938, Basil Abaskin, E. A. Nieschmidt, R. H. Lovald, and F. A. Hayes.

"Soil Survey of Gosper County, Nebraska," U. S. D. A., Washington, D. C., Series 1934, No. 8, May 1938, W. J. Moran.

"Soil Survey of Wyoming County, New York," U. S. D. A., Washington, D. C., Series 1933, No. 16, Mar. 1938, C. S. Pearson, D. G. Greenleaf, H. R. Adams, and Winston Neely.

"Soil Survey of Pamlico County, North Carolina," U. S. D. A., Washington, D. C., Series 1934, No. 2, Dec. 1937, John T. Miller and Arthur E. Taylor.

"Soil Survey of Jones County, North Carolina," U. S. D. A., Washington, D. C., Series 1934, No. 4, Mar. 1938, W. A. Davis, K. V. Goodman, and Z. C. Foster.

"Soil Survey of Surry County, North Carolina," U. S. D. A., Washington, D. C., Series 1932, No. 20, Oct. 1937, W. A. Davis and E. F. Goldston.

"Soil Survey of McIntosh County, Oklahoma," U. S. D. A., Washington, D. C., Series 1933, No. 11, Jan. 1938, E. W. Knobel and O. H. Brensing.

"Soil Survey of Carter County, Oklahoma," U. S. D. A., Washington, D. C., Series 1933, No. 18, June 1938, E. G. Fitzpatrick and W. C. Boatright.

"Soil Survey of Pocahontas County, West Virginia," U. S. D. A., Washington, D. C., Series 1933, No. 14, Feb. 1938, B. H. Williams and H. M. Fridley.

Crops

¶ In Georgia Coastal Plain Experiment Station Circular 6, "Establishing Improved Pastures in the Coastal Plain of Georgia," by Director S. H. Starr, there are many helpful suggestions on improving pasture land in the coastal section of the State. With the number of beef cattle in Georgia doubled during the 5-year period from 1929-1935, Director Starr declares that it is essential to provide improved pastures to furnish cheap and abundant feed. On practically every farm there is some waste land bringing in little or no return that could be converted into an improved pasture. Bearing out this statement, reference is made to the approximately 10,000,000 acres in swamps, branch bottoms, cut-over pine woods, and marginal lands lying south of middle Georgia, much of which could be utilized for pastures in conjunction with producing timber and naval stores. Investigations have shown that introduced grasses and legumes supplementing the less desirable native grasses make satisfactory lowland pastures, provided drainage and the removal of undergrowth and worthless trees are properly handled.

Common lespedeza, carpet grass, Dallis grass, and white clover have proved a good mixture for lowlands. Experimental results have shown that from 400 to 600 pounds of a complete fertilizer analyzing 6 per cent ammonia, 12 per cent phosphoric acid, and 6 per cent potash when used in early spring more than doubles the gain in pounds of beef per acre as compared with an area receiving no fertilizer. Where pastures are fertilized over a period of years, the 6-8-6 analysis is believed a practical fertilizer. It is stated that upland pastures have not produced as favorable results as the lowland pastures due to the occurrence of droughts almost every year. A combination of Bermuda grass and common lespedeza is the best mixture for the upland pasture, though Kudzu furnishes excellent grazing on the heavier types of soil.

A number of good illustrations make clearer the main points in this instructive circular.

¶ Cornell Extension Bulletin 384, "The Planting and Early Care of the Apple Orchard," by Joseph Oskamp, contains much excellent material that should be of particular value to apple growers in New York State. According to the author, the most successful apple orchards have been profitable chiefly because of a fundamentally good set-up, which has to be largely determined at planting time, since it can not be readily changed later. A good set up includes the choice of a favorable location and soil, selection of standard varieties with provision for cross pollination, proper spacing of permanent trees, and the planting of a good sized orchard.

Under the heading of fertilization, emphasis is given to the fact that as agricultural soils grow older there is an increasing tendency for deficiencies to develop. While experiments in the main have shown that apple trees seldom respond to fertilizers other than nitrogen, this does not preclude that the other elements are never deficient. While the extensive root area and perennial nature of fruit trees make them less responsive to complete fertilizers, they are often applied in the establishment of cover crops or permanent sods in the orchard. Many other instructive topics are also outlined in some detail, among these being pertinent advice concerning soil management, the nursery stock, pruning, and spraying.

"Seasonal Changes in the Chemical Composition of Some Arizona Range Grasses," Agr. Exp. Sta., Tucson, Ariz., Tech. Bul. 73, June 15, 1938, E. B. Stanley and C. W. Hodgson.

"Vegetable Crop Rotation," Agr. Ext. Serv., Storrs, Conn., Bul. 255, Jan. 1938, Albert E. Wilkinson.

"Sweet Corn," Agr. Ext. Serv., Storrs, Conn., Bul. 257 (Revision of No. 190), Jan. 1938, Albert E. Wilkinson.

"4-H Vegetable Gardens," Agr. Ext. Serv., Storrs, Conn., Bul. 262 (Revision of No. 242), Apr. 1938, Garry A. Miles.

"Late Cabbage," Agr. Ext. Serv., Storrs, Conn. Bul. 256 (Revision of 193), Jan. 1938, Albert E. Wilkinson.

"Strawberry Production," Agr. Ext. Serv., Gainesville, Fla., Bul. 97 (Revision of 63 in Part), May 1938, A. N. Brooks and Harold Mowry.

"Crimson Clover for Fertilizer, Feed, and Soil Protection," Agr. Ext. Serv., Athens, Ga., Bul. 452, Revised June 1938, E. D. Alexander.

"Oil Variations of Tung Trees," Agr. Exp. Sta., Experiment, Ga., Cir. 115, May 1938, T. A. Pickett and W. L. Brown.

"Flax Production in Idaho," Agr. Exp. Sta., Moscow, Idaho, Bul. 224, Mar. 1938, K. H. W. Klages.

"Forty-five Years of Service to Idaho Agriculture, the Annual Report of the Agricultural Experiment Station for the Year Ending December 31, 1937," Agr. Exp. Sta., Bul. 225, May 1938.

"Fiftieth Annual Report for the Year 1937, Part 1, Report of the Director," Agr. Exp. Sta., Lexington, Ky., Jan. 1, 1938, Thomas P. Cooper, Dir.

"Lawn Management," Agr. Ext. Serv., Amherst, Mass., Leaf. 85, Revised June 1937, Lawrence S. Dickinson.

"The Quarterly Bulletin," Agr. Exp. Sta., East Lansing, Mich., Vol. 21, No. 1, Aug. 1938.

"Water Conditioning for Greenhouses," Agr. Exp. Sta., East Lansing, Mich., Cir. Bul. 166, Aug. 1938, C. H. Spurway and C. E. Wildon.

"A Study of Wilt Resistance of Cotton in South Mississippi," Agr. Exp. Sta., State College, Miss., Cir. No. 99, Feb. 1938, D. C. Neal.

"Fifty Years in the Service of Agriculture 1888-1938," Agr. Exp. Sta., Columbia, Mo., Bul. 397, June 1938, F. B. Mumford, Dir.

"Wheat in Missouri," Agr. Exp. Sta., Columbia, Mo., Bul. 398, July 1938, W. C. Etheridge and C. A. Helm.

"Fiftieth Annual Report of the Board of Control for the Fiscal Year Ending June 30, 1937," Agr. Exp. Sta., Reno, Nev., 1938.

"Strawberry Culture," Agr. Ext. Serv., Durham, N. H., Ext. Cir. 211, Mar. 1938, L. P. Latimer.

"Agricultural Research in New Hampshire, Annual Report of the Director of New Hampshire Agricultural Experiment Station for the Year 1937," Agr. Exp. Sta., Durham, N. H., Bul. 304, Mar. 1938, J. C. Kendall, Dir.

"Legume and Grass Silage, A Survey of Methods and Results on 380 Northeastern Farms," Agr. Exp. Sta., Durham, N. H., Bul. 305, Apr. 1938.

"Experiments with Grass Hay," Agr. Exp. Sta., Durham, N. H., Sta. Bul. 306, May 1938, F. S. Prince, T. G. Phillips, P. T. Blood, and G. P. Percival.

"Cabbage," Agr. Ext. Serv., Durham, N. H., Ext. Cir. 212, May 1938, J. R. Hepler.

"Fifty-eight Annual Report of the New Jersey State Agricultural Experiment Station and the Fiftieth Annual Report of the New Jersey Agricultural College Experiment Station for the Year Ending June 30, 1937," Agr. Exp. Sta., New Brunswick, N. J.

"Recommended Varieties of Field Crops for New Jersey," Agr. Exp. Sta., New Brunswick, N. J., Cir. 378, June 1938, Howard B. Sprague.

"Legume and Grass Silage, A Survey of Methods and Results on 380 Northeastern Farms," Agr. Exp. Sta., New Brunswick, N. J., Bul. 643, Apr. 1938.

"Increasing the Protein Content of Timothy, Without Sacrificing Yield, by Delayed Applications of Nitrogenous Fertilizers," Agr. Exp. Sta., New Brunswick, N. J., Bul. 644, May 1938, Howard B. Sprague and Arthur Hawkins.

"Ensiling Green Crops with Molasses," Agr. Ext. Serv., New Brunswick, N. J., Ext. Bul. 198, Feb. 1938, C. B. Bender and H. H. Tucker.

"Early-cut, Nitrogen-fertilized Timothy Hay as Compared with Alfalfa Hay for Feeding Dairy Cows," Agr. Exp. Sta., Ithaca, N. Y., Bul. 694, Apr. 1938, G. W. Salisbury and F. B. Morrison.

"Fifty-ninth Annual Report of the North Carolina Agricultural Experiment Station for the Fiscal Year Ending June 30, 1936, Progress Report for Year Ending December 1, 1936," Agr. Exp. Sta., Raleigh, N. C., R. Y. Winters, Dir.

"Sixtieth Annual Report of the North Carolina Agricultural Experiment Station for the Fiscal Year Ending June 30, 1937, Progress Report for Year Ending December 1, 1937," Agr. Exp. Sta., Raleigh, N. C., R. Y. Winters, Dir.

"Beautifying the Home Grounds, Arrangement of Planting," Agr. Ext. Serv., Raleigh, N. C., Ext. Folder No. 40, June 1938, John H. Harris.

"Beautifying the Home Grounds, General Arrangements," Agr. Ext. Serv., Raleigh, N. C., Ext. Folder No. 41, June 1938, John H. Harris.

"Beautifying the Home Grounds, Walks and Drives," Agr. Ext. Serv., Raleigh, N. C., Ext. Folder No. 42, June 1938, John H. Harris.

"Lettuce Growing in North Carolina," Agr. Exp. Sta., Raleigh, N. C., Bul. 319, June 1938, Robert Schmidt.

"Garden Roses," Agr. Ext. Serv., Columbus, Ohio, Bul. 95, Revised Feb. 1938, Alex Laurie.

"Home Gardening," Agr. Ext. Serv., Columbus, Ohio, Bul. 116, Apr. 1938, E. R. Lancashire.

"Better Pastures for Ohio Livestock," Agr. Ext. Serv., Columbus, Ohio, Bul. 154, Revised Feb. 1938, D. R. Dodd and R. M. Salter.

"The Bimonthly Bulletin," Agr. Exp. Sta., Wooster, Ohio, Vol. XXIII, No. 193, July-August 1938.

"Guide to the Agricultural Experiment Station," Agr. Exp. Sta., State College, Pa., Bul. 360, May 1938.

"Fiftieth Annual Report Rhode Island State College Agricultural Experiment Station," Agr. Exp. Sta., Kingston, R. I., Contb. 520, June 1938.

"The Effect of Magnesic Versus Calcic Liming Materials on Calcium in Vegetables, Forage Crops, and on Certain Soil Properties," Agr. Exp. Sta., Kingston, R. I., Bul. 263, May 1938, Donald R. Willard and John B. Smith.

"Annual Report of the South Dakota Agricultural Experiment Station for the Fiscal Year Ending June 30, 1937," Agr. Exp. Sta., Brookings, S. D.

"Alfalfa in the Tennessee Farm Program," Agr. Ext. Serv., Knoxville, Tenn., Pub. 213, Aug. 1938, H. E. Hendricks.

"The Fruit Tree Situation in Utah," Agr. Exp. Sta., Logan, Utah, Bul. 279, Apr. 1938, A. L. Wilson and A. L. Stark.

"Digestibility of Alfalfa, Timothy, and Soybeans as Silages and as Hays," Agr. Exp. Sta., Burlington, Vt., Bul. 430, Mar. 1938, J. A. Newlander, H. B. Ellenberger, O. M. Camburn, and C. H. Jones.

"A Study in Recovery of Transplanted Apple Trees," Agr. Exp. Sta., Burlington, Vt., Bul. 432, Mar. 1938, M. B. Cummings and R. G. Dunning.

"Legume and Grass Silage," Agr. Exp. Sta., Burlington, Vt., Bul. 434, May 1938, O. M. Camburn, H. B. Ellenberger, J. A. Newlander, and C. H. Jones.

"What's New in Farm Science, Part II, Annual Report of the Director," Agr. Exp. Sta., Madison, Wis., Bul. 440, May 1938.

"Quincy Growing," U. S. D. A., Washington, D. C., Leaf. 158, May 1938, H. P. Gould.

"The Velvetbean," U. S. D. A., Washington, D. C., Farmers' Bul. 1276, Revised May 1938, C. V. Piper, W. J. Morse, and Revised by W. J. Morse.

"Watermelons," U. S. D. A., Washington, D. C., Farmer's Bul. 1394, Revised May 1938, W. R. Beattie.

"Nitrogen-fixing Bacteria and Legumes," U. S. D. A., Washington, D. C., Farmers' Bul. 1784, Dec. 1937, Lewis T. Leonard.

"Methods of Making Silage from Grasses and Legumes," U. S. D. A., Washington, D. C., Tech. Bul. 611, Mar. 1938, T. E. Woodward and J. B. Shepherd.

"Motion Pictures of the U. S. Department of Agriculture, 1938, U. S. D. A., Washington, D. C., Misc. Pub. 288, Apr. 1938.

Economics

¶ The depression and resulting low levels of farm prices undoubtedly had considerable influence on the development of interest in cost-of-production studies. Recently, the Maine Agricultural Experiment Station at Orono published the results of its cost-of-production studies in the potato-producing areas of Aroostook County, Maine. The publication is Bulletin 390, and was written by W. E. Schrumpf. The material for the study was obtained by the survey method directly from a cross section of the potato producers. The purpose of the work was to determine the cost and returns on farms in each of three areas, the Saint John, the Presque Isle, and Houlton, and to find some clue as to the effect of such factors as size of the potato enterprise, yield rate, and labor efficiency, etc., on the cost and returns.

In general, the factors of efficiency which prevailed at the time of the survey may be considered to be in force today, although about 8 years have passed since 1930, the last year in which surveys were taken. A method of bringing the cost factors up to date is explained in the bulletin. Perhaps the most important changes that one would notice, if the study could be repeated as of the present time, would be in the use of fertilizers and the various types of machinery, particularly farm tractors. Especially interesting is the section on fertilizers. It is common knowledge that the potato-producing areas of Maine are outstanding in the intensity of the use of commercial plant food.

On the Houlton farms for instance, .99 of a ton of fertilizers was applied per acre, whereas in Presque Isle the average was .94, and on certified-seed-producing farms .94 ton was used. It was noted also that the fertilizer of 5-8-7 formula at that time was the most general, and 5-7-10 was the second in importance. Expressed in other terms, about 429 pounds of plant food (nitrogen, phosphoric acid, and potash combined) were applied per acre to potatoes on the certified-seed farm, 428 pounds on the Presque Isle farms, and 421 pounds on the Houlton farms. The proportion of nitrogen ranged about 21% in all cases, but on the Presque Isle and Houlton farms, phosphoric acid was slightly in excess of potash, while on the certified-seed groups the

largest proportion was potash. Fertilizers are important because yield is one of the major factors in reducing the cost of production and of course in producing a profit on the farm. It was noted in this connection that an increase of about 93 pounds per acre in the use of plant food over the lower applications resulted in an average increase of 8 barrels of potatoes.

The bulletin contains much information about the potato enterprise in Maine. For instance, the farm capital averaged $40,184 on the certified-seed farms, $31,100 on the Presque Isle farms, and $17,896 on the Houlton farms, indicating that the potato producer in Maine operates on a fairly large scale with an average annual gross income of $15,120, $9,815, and $6,512 respectively in each group. The labor income at that time ranged from $2,134 to $689. Farms above average in the three factors, size of business, yield-rate of potatoes, and labor efficiency, had larger net returns per barrel of potatoes than the average of all the farms in each of the three groups.

"Hired Labor Requirements on Arizona Irrigated Farms," Agr. Exp. Sta., Tucson, Ariz., Bul. 160, May 1938, E. D. Tetreau.

"Head-lettuce Production in California," Agr. Ext. Serv., Berkeley, Calif., Cir. 105, Jan. 1938, A. A. Tavernetti and John B. Schneider.

"1937 Walnut Production Cost Analysis Orange County, Nine-Year Summary 1929-1937," Agr. Ext. Serv., Berkeley, Calif.

"Economic Digest for Connecticut Agriculture," Agr. Ext. Serv., Storrs, Conn., No. 71, May 1938.

"Statistical Information Pertaining to the Marketing of Agricultural Products in Connecticut 1937," State Dept. of Agr., Hartford, Conn., June 1938, Frances T. Setsky.

"Retail Marketing of Apples by a Chain Store Warehouse in Philadelphia," Agr. Exp. Sta., Newark, Del., Bul. 208, Mar. 1938, Harry S. Gabriel.

"Seventh Annual Summary Florida Citrus Costs and Returns," Agr. Ext. Serv., Gainesville, Fla., Misc. Pub. 26, July 1938, R. H. Howard.

"Illinois Farm Economics," Agr. Ext. Serv., Urbana, Ill., Nos. 38 and 39, July and Aug. 1938.

"Maine Fruit Notes," Agr. Ext. Serv., Orono, Maine, Vol. 12, No. 6, Aug. 1938, A. K. Gardner and R. N. Atherton.

"Crop Report for Michigan," Dept. of Agr., Lansing, Mich., Aug. 1938.

"Farm Business Notes," Agr. Ext. Serv., University Farm, St. Paul, Minn., Nos. 187 and 188, July and Aug. 1938.

"Rural Land Use Activities in Missouri," Agr. Exp. Sta., Columbia, Mo., Bul. 399, July 1938, Ross J. Silkett.

"Montana Farm Bankruptcies, A Study of the Number, Characteristics, and Causes of Farm Bankruptcies Over a Forty-year Period with Some Suggestions for Preventing Them in the Future," Agr. Exp. Sta., Bozeman, Mont., Bul. 360, June 1938, R. R. Renne.

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That's What They Call 'em

(*From page* 17)

this country, and just worry along with traveller's joy, careless weed, impudent lawyer, and puncture vine. Then, when I'm poking around the garden I guess I'll sort of encourage Venus' looking-glass, l'amourette, and eye-bright, and maybe they'll crowd out old maid's hands, crowfoot, and old maid's nightmare. And of course, as a last resort, there's always amor platonico.

Soils and Soil Management

A NEW edition of the popular book, "Soils and Soil Management," has been prepared by C. E. Millar, head of the Soils Department of Michigan State College (Soils and Soil Management. Webb Book Publishing Company, St. Paul, Minnesota, 1937, $3.00). This edition comes 8 years after the first and brings up to date various tables and data, in addition to permitting certain revisions in the text to keep step with newer developments and findings in the field of soil science.

The book tells in a practical way how to manage the most important resource of the farm, and of the nation, the soil. It is written primarily as a text for use in teaching agricultural students in high school, although its usefulness is by no means confined to this group. Farmers, farm managers and advisers, and all dealing with the problems of managing soils so as to produce crops efficiently and still maintain or build up the fertility of the soil, will find the book of great practical help. Chapters on gardens and home ground management will appeal to the suburbanites who are frequently confronted with the perplexing problem of what to grow and how to grow it.

The first chapter considers factors important in the selection of the farm, and is followed by chapters on soil formation and classification. The next three chapters are devoted to tillage of the soil from the seed-bed preparation to the "laying by" of the crop. The problems of soil moisture are then discussed. Following a chapter on crop rotation, come five chapters dealing with fertilizers in all their practical aspects as related to the soils and crops on the farm. Two chapters cover the problem of soil erosion and its control, and two more that of organic matter and its maintenance. Following these are chapters devoted to liming, the farming of acid soils, alkali soils, the growing of legumes to add nitrogen to the soil, and the biology of the soil. The final chapters might be termed specialty chapters and are devoted to the farming of sandy soils, pasture management, gardening, and the home grounds.

Special attention should be called to the manner in which the subject matter of the book is presented. The practical aspects have constantly been kept in mind, and in order to bring out even more clearly these points, the chapters

are arranged on the problem basis, considerable ingenuity in this respect having been exhibited. Exercises designed to show the application in practice of the principles discussed are given at the end of the chapter. These are followed by problems for students to work out. References are included, adding to the value of the book for those desiring further information on any particular subject. A convenient glossary of technical terms is found at the end of the book.

The book is applicable particularly to agriculture north of the Cotton Belt, but the general fundamental principles of soil management so well explained will apply anywhere. Illustrations are numerous and well chosen to accompany the text, and the printing is very clear and large enough to enable easy reading. The equally clear and readable style in which the book is written is added reason to expect that it will have a wide appeal and enjoy even greater popularity than the first edition.

Potash Saves Alfalfa, Clover, and Soybeans

(*From page* 8)

are well-brought-out in the pictures shown in figures 1, 2, and 3.

Special mention should be made of the increased yield for the 1937 first cutting of alfalfa on the potash-treated plots as compared with the yield from the plots without potash. For the legume section, the increase is 186%.

Four tons of alfalfa, which is a good acre-yield for three cuttings, will remove about 68 pounds of potash (K_2O), and 130 pounds of lime (CaO). It would require 136 pounds of 50% muriate of potash annually to meet this potash demand, not to mention the amount required to replace that lost through leaching and soil erosion. To replace the lime removed by the 4 tons of hay would require 232 pounds of pure calcium carbonate.

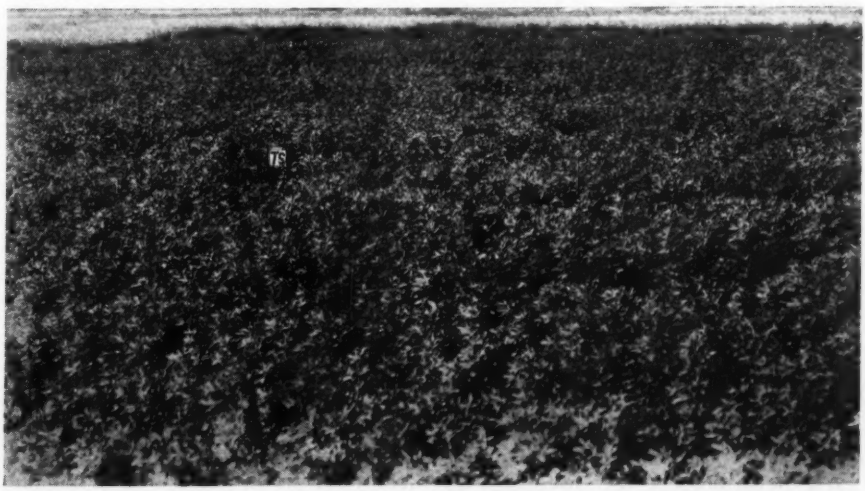

Fig. 3. Alfalfa (Plot 76) on Sassafras loam soil which now receives 50 lb. of actual potash (K_2O) to the acre (formerly 25 lb.). Note thickness and evenness of the growth as compared with Plot 74 (the same stake was used for the number in each case).

There are thousands of acres of alfalfa in New Jersey which could be distinctly improved by the use of lime to correct soil acidity, and potash to balance the annual losses.

When the conditions are made *right*, this crop and also clover and soybeans do not give weeds a *chance* to grow. Furthermore, the life of the fields would thus be prolonged.

Bur Clover Is Good for Soils and Pasture

(*From page* 16)

tive in its soil requirements than vetch or winter peas, and for this reason it would be well in the beginning to plant only on the best acres, using lime, phosphorus, and potash to supply the plant food in which the soil may be deficient. Thus at Holly Springs, where in the past bur clover had never grown so well as vetch, winter peas, or crimson clover, we have several acres this year just as good as any ever seen anywhere —but after fertilizing the land before planting with good applications of superphosphate and muriate of potash. In fact, this is why we think the Delta has made so much more progress than the hills in growing winter legumes of all kinds, the soils in the Delta having, as a rule, good supplies of the minerals, whereas most soils in the hills need phosphates and potash, and many of them lime.

Bur clover is entirely too expensive a crop to plant over large acreages where the seed have to be bought on the regular markets and freighted to their destination. Many county agents and soil erosion specialists are encouraging their cooperators to plant small seed patches to bur clover, fertilize these well, sow at least 10 bushels of seed per acre in early September on the tops of the cotton beds, leave to be covered by succeeding rains, and nothing else done until the foliage dies in the spring and the seed are ready to be harvested. Ordinary garden rakes for removing the vines and trash, followed by wire or even house-brooms for sweeping up the seed, are about as cheap as any more complicated method, though some large growers use specially constructed suction machines for gathering up the burs. Two hundred to four hundred bushels of seed in burs are not uncommon yields per acre, especially on the well-fertilized seed patches.

It is doubtful if bur clover as a soil builder has any advantages over vetch, winter peas, or crimson clover, but it does have considerable advantage in its ability to make seed, in the ease with which the seed may be saved, and particularly in the persistence with which these seed remain dormant in the soil and continue to give stands for years after. Crimson clover seeds about as freely, but these seeds have to be saved with expensive machinery and during very short periods of time, and if turned into the soil, all usually will germinate with the first rain and be killed during the hot summer.

As a further illustration of the value of bur clover, during the recent fall Delta farmers who used it in 1937 found themselves at a considerable advantage over others who had used vetch or peas. Summer rains caused the cotton to grow exceptionally tall, to fruit heavily, and when winds which came later blew over and tangled these cotton stalks, they were never able to straighten so that vetch or peas could be planted and covered in the usual way. The consequence was that many of these planters, being under contract with the government to sow winter legumes, had to resort to the use of aeroplanes and sow their vetch or peas much as they had dusted their cotton from the

air in fighting the boll-weevil. Even where a good distribution of the seed was obtained, they had a tendency to drift to the bottoms of the rows where they germinated, but were damaged much more by wet weather than if they had germinated on the tops or sides of the beds. On the other hand, growers who had used bur clover had this already seeded. The seed worked to the sides and tops of the rows and suffered no ill effects from lack of fall plowing of the land. As a consequence, bur clover has gained added prestige in a section where already it had made many friends.

Soil and Fertilizer Needs of Apple Orchards

(*From page* 13)

a satisfactory crop is fairly certain. In contrast, spurs similar to the two others illustrated do not have sufficient vigor to develop good fruit buds. Even if such spurs do bloom, they are low in reserve foods, weak, and consequently seldom set fruit.

The growth status of trees can be estimated during the dormant season by noting the number and vigor of fruit spurs and the amount and vigor of twig growth. Thus, figure 4, #1 illustrates a strong, well-developed fruit bud. The swollen, scar-like formations on the spur indicate that it has been fruitful in past years. In contrast, figure 4, #2 illustrates a spur which is several years old, as indicated by the annual growth rings. This spur is terminated by a small, slender bud which will not bloom. The fact that this spur is straight and shows no fruiting scars indicates that it has always been unproductive. Trees which possess one or more medium-large or large spur buds on every 10 to 15 inches of fruiting wood are considered to be in a good, productive growth status. On the other hand, if a majority of the spur buds are small and very few medium-sized buds are present, the trees are obviously unproductive. Such trees will not become productive until the growth status of the spurs has been improved considerably.

Sod and cover crop plants, and weeds may be used as valuable indicators of orchard soil conditions. The plants usually grow rapidly but possess relatively small reserves of nutrients and, therefore, they respond more quickly to changes in the soil environment than do the trees. Because of this the fruit grower should make frequent and careful observations of the sod, cover crop, or weed growths in his orchards and use them as one means of studying his soil conditions.

Where only a poor growth of sorrel, crab grass, or Erigeron predominates, the soil is rather low in fertility. Where sedges are common, soil moisture is plentiful and drainage and aeration may be unsatisfactory for apple trees. Where fairly thick stands of vigorous plants of lambs quarter, red root, wild turnip, white and red clover, dandelions, and plantain are found, the soil is in a good state of fertility. The relative size of the weeds also is a valuable index of soil fertility. Some plants, such as the wild mustards, dandelions, plantain, and orchard grass, may be two or three times as large on fertile soils supplied with adequate moisture as they are on poor soils.

Since soils vary widely in fertility, one must estimate this factor before an intelligent beginning can be made upon a soil management or fertilizer program. Good farmers can judge the fertility of most farm land by observing the appearance of the soil itself and the way cultivated plants and weeds grow upon it. Fertilizer demands are apt to be greatest in orchards located on the light, sandy, and gravelly-sandy

classes of soils. These soils in general are not naturally well supplied with nutrients, and those present become available too slowly to permit satisfactory growth without the use of fertilizers. Furthermore, these soils are low in organic matter and in colloids; consequently, they do not hold nutrients well when subject to leaching. Many of the coarse-textured soils derived from granitic material in mountainous regions also belong to this group.

Soils that are very acid are likely to become deficient in plant nutrients. A high degree of acidity is not uncommonly found in orchards where large quantities of sulphur sprays are used. An acid soil condition favors a rapid loss of calcium and magnesium, and renders potassium and phosphorus less available to plants. This condition may also result from the continued use of acid-forming fertilizers, if lime is not applied periodically.

More Accurate Diagnosis

Within recent years, there has been developed rapid chemical soil tests which, although not yet perfected, constitute a definite addition to our system of soil diagnosis. In many cases, these tests have been very helpful in indicating the supplies of available potassium, phosphorus, calcium, and magnesium in orchard soils. They have proven particularly advantageous in diagnosing or verifying conditions indicated by the trees or by the cover crop or sod growth. In general, the readings obtained for nitrogen by the rapid soil tests should not serve as a guide for fruit growers. The nitrogen requirements of orchard soils should be determined by the trees and cover crop or sod growth.

As indicated earlier in this discussion, there are environmental conditions in which apple trees make a liberal to excessive growth. Under such conditions they may show little or no beneficial response to applications of fertilizer. In general, however, orchards planted upon coastal plain soils or other sandy or gravelly-sandy soils will be benefited by annual applications of a complete fertilizer. The repeated application of a single nutrient, nitrogen, combined with clean tillage, in recent years, has resulted in some instances in serious "mining" of soil resources.

It has been established that the fertilizer requirements of bearing apple orchards will vary somewhat according to the environment, varieties, growth status of the trees, fertility of the soil, and system of soil management. As a guide, the following suggestions may be given:

1. In apple orchard environments, such as 3 and 4, it is highly important to promote a good growth of cover crops as well as of the trees. In order to insure such development, particularly with legumes, it is advisable to maintain a favorable soil reaction (pH) and provide an adequate supply of available phosphate and potash, calcium, and magnesium.

2. On soils derived from acid materials, lime should be applied periodically in order to maintain a favorable reaction (above pH 5.5 or 6.0) and an adequate supply of available calcium and magnesium.

3. Soils which are deficient in nutrients, particularly nitrogen, and where neither cover crops, weeds, nor trees are making enough growth, should receive an annual application of 600 to 800 pounds per acre of a 5-10-5 fertilizer applied broadcast.

4. Soils which are moderately fertile and which support a good growth of cover crops, weeds, and trees should receive a basic application of 500 to 1,000 pounds per acre of a 3-12-6 fertilizer.

5. The trees should be examined carefully during early June, and additional nitrogen supplied if needed.

6. In moist seasons and in orchards containing varieties susceptible to blight, this application should be reduced somewhat or only the lower amount used.

7. Where a heavy crop of sweet clover or alfalfa has been grown for a year or more, it may be advisable to reduce the amounts of fertilizer.

8. Orchards that are mulched freely generally require a different fertilizer treatment than others. Straw, hay, and other material used for mulching purposes in orchards contain appreciable quantities of plant nutrients. If the mulch is maintained over a period of years, these materials gradually enrich the soil and reduce the need for fertilizers, particularly nitrogen.

Balanced Fertilizers Make Fine Oranges

(*From page* 9)

vival. To get fine fruit along with production, he is further convinced that balanced fertilization is of the greatest importance.

In this plan of balanced feeding, potash fertilizer is given due credit for its favorable influence on fruit quality. Mr. Break uses potash regularly and believes in it, because his fruit has won not only many prizes at the National Orange Shows at San Bernardino, but the best prize of all—a fine reputation on the market. No questions are asked when his brand is up for sale. Buyers know it is "tops" in juice, weight, flavor, and keeping quality. It is a fact that even the workers who truck the boxes of these oranges notice the difference in weight per box and often remark that they are much heavier than average.

As an example of the fruit production being obtained, one portion of the grove can be cited, which is on very old stock, in fact some of the original stock was brought in from Florida 50 years ago. The average production for the past few years on this part has been 500 boxes of navels per acre, which is quite remarkable for trees of this kind.

The fact that Mr. Break was chosen recently as one of the agricultural representatives from this country on an important international commission is a

Wesley Break admiring one of the large trees for which the grove of Allen Break and Sons is famous.

fine tribute to his ability and influence in the citrus industry. While in Europe, he naturally studied the intensive agriculture of the Continent and was especially interested in the systematic use of fertilizer. He returned with his belief in the value of potash and a balanced fertilizer program more firmly implanted than ever. He believes that his former application of about 1 pound of commercial potash per tree may not be enough to fully bring out the good effects of this plant food. To observe its effects, this year he will start a program of about 3 pounds of commercial potash per tree in the form of mixed fertilizer on part of this grove.

While the soils in some groves in Southern California have enough available potash for a high level of citrus production, many soils have only enough for limited crops. If the trees are stimulated without the use of potash fertilizer, the balance for the combination of high production, vigorous trees, and quality fruit is upset. Under these circumstances, which become more common as one important plant food is used to the exclusion of another, potash can be used profitably. Mr. Break has proven this, and evidence of a like nature, that potash increases weight, juice volume, and all-around fruit quality, is rapidly appearing in many groves.

Boron Deficiency Becomes a Problem in Michigan

(*From page* 21)

As the experiments were conducted, considerable variation was noted in the response of the different crops to applications of boron in the form of $Na_2B_4O_7$.

Alfalfa. Planted on April 1, this crop first showed definite symptoms of boron deficiency during the first few days in June, just about the time the first blossoms appeared. A reddening of some of the leaves was first noticed. The red or bronze color first appeared near the tips of the leaves and on the under side between the more prominent veins. From there the color spread until it included almost the entire surface and was noticeable on the top as well as the under side. After the leaves had been red for several days they turned yellow and died. While this work was in progress, similar observations in the case of alfalfa were reported by McLarty, Wilcox, and Woodbridge.

The pot cultures showed very distinctly that the red or bronze coloration was almost entirely eliminated and much greater yields obtained by a total application of 0.003 gms. $Na_2B_4O_7$ per pot. Furthermore, this control lasted through three cuttings with distinct differences in growth still apparent in the early growth of the fourth crop. The data presented in table 1 show the effect of the treatment on the yields of alfalfa.

TABLE 1.—THE EFFECT OF BORON ON THE YIELD OF ALFALFA GROWN IN QUARTZ SAND CULTURES

Treatment	Yield in grams (Average of 4 Pots)		
	July 8	Aug. 12	Oct. 30
$Na_2B_4O_7$—0.003 gms. per pot....	5.15	3.95	2.80
No boron.....	3.63	2.28	1.70

On July 8 alfalfa was planted in 2-gallon jars filled with soil from two fields where in 1936 sugar beets had been seriously injured by heart rot. Four jars of each soil received no boron, while four received 2 pounds of $Na_2B_4O_7$ per acre. The results, presented in table 2,

show that 4.3 and 18.4 per cent increases in yield of alfalfa were obtained on the dates indicated as a result of the boron application to the Gilford soil, while the increases in yield on the Nappanee soil on the same dates amounted to 14.4 and 14.1 per cent.

TABLE 2.—THE EFFECT OF BORON ON THE YIELD OF ALFALFA GROWN ON TWO BORON DEFICIENT SOILS* IN POT CULTURES

Treatment	Yield in Grams (Average of 4 Pots)			
	Nappanee Soil		Gilford Soil	
	Nov. 16	Jan. 17	Nov. 16	Jan. 17
$Na_2B_4O_7$—2 lb. per acre	9.5	6.4	7.3	4.5
No boron	8.3	5.6	7.0	3.8

* The soils were considered to be deficient in boron because they had produced sugar beets afflicted with heart rot.

Red and Alsike Clover. As a result of certain observations in the field during the latter part of July, the possibility became apparent that a deficiency of boron might produce symptoms in red and alsike clovers very similar to those produced in alfalfa. To test this possibility, both of these crops were planted in quartz cultures on July 28 and August 18. For some reason, not surely known, the red clover died before yields or pictures were taken, but in the early stages it showed differences in growth in favor of applied boron, and the deficiency symptoms were very similar to those occurring on alfalfa. Only one difference was noticeable. The reddening of the red clover leaves started in the veins of some of the leaves, while in the case of other leaves the first indications of red were between the veins as in alfalfa.

Alsike clover showed a very definite response to application of boron. When planted in quartz cultures the plants not treated with boron made very little growth and soon turned red. After a short time in this condition the leaves turned yellow, and the plants would soon have died had they not been harvested. The differences in yield, shown by the data in table 3, were more pronounced than in the case of alfalfa. Figure 7 shows appearance of the plants 90 days after planting.

TABLE 3.—THE EFFECT OF BORON ON THE YIELD OF ALSIKE CLOVER GROWN IN QUARTZ SAND CULTURE

Treatment	Yield in Grams (Average of 4 Pots)
	Nov. 16
$Na_2B_4O_7$—0.002 gms. per pot	2.22
No boron	0.80

As a further check on the boron deficiency symptoms in alsike clover, sandy loam soil was gathered from a place on the college farm where the symptoms occurred. On August 18 the clover was planted in pots filled with this soil. The only treatment was an application of 3 pounds of $Na_2B_4O_7$ per acre on one-half of the jars. There appeared at first to be a slight injury, evidenced by slower growth, as a result of the boron application, but the evidence of this soon disappeared, and slight deficiency symptoms in the nature of reddened leaves appeared on the untreated plants. As evidenced by figure 8, the plants treated with boron matured earlier than did those not treated.

Sweet Clover. Experiments with sweet clover produced results somewhat similar to those obtained with the common clovers and alfalfa. Differences in yield as a result of boron applications were not so great as in the other crops, and the red and bronze coloration in the leaves was not as pronounced. It is believed that in the case of this crop there is more of a tendency for the leaves to turn yellow without passing through the red and bronze stage.

Barley, Beans, Buckwheat, Corn, Oats, and Rape. In the 1937 experi-

ments barley, beans, and corn were raised in quartz sand cultures by planting the seeds in the usual manner. None of the crops showed indications of a need for boron. It was thought that perhaps there was enough boron in the seeds to supply the needs of the plants.

search was made for symptoms of boron deficiency in the alfalfa fields of various sections of the State. At this time the symptoms were most pronounced in the area around Unionville and Sebewaing where heart rot of sugar beets was most serious in 1936.

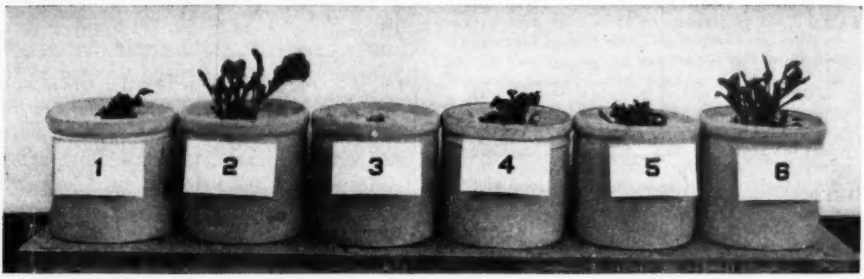

Fig. 6. The effect of boron on the recovery of sugar beets grown in the field and inflicted with heart rot. 1 and 2 represent halves of one beet, 3 and 4 of a second beet, and 5 and 6 of a third beet. The odd numbered jars (1, 3, and 5) received complete nutrients, minus boron, while the even jars received 0.002 gms. $Na_2B_4O_7$ per pot in addition to complete nutrients.

To determine whether or not this was true, new cultures were prepared during the spring of 1938, and barley, beans, corn, and oats were transplanted into the cultures after the seeds had been removed from the transplants. Thus the plants could have obtained only a very small quantity of boron from the seeds.

After the first crops of beans, buckwheat, and corn were harvested, a second crop was immediately planted. One crop of rape was also grown.

Despite all the precaution to eliminate boron from the culture, none of these crops showed symptoms of boron deficiency. This is, no doubt, due to the small quantity of boron which is needed by these crops. According to Bertrand and Silberstein certain members of the Gramineae contain only 2.3 to 5 mg. of boron per kg. of dry matter, while the legumes are relatively high in boron, with red clover, for example, containing 36.2 mg. per kg. of dry matter.

While the boron deficiency symptoms were being checked in the greenhouse, the writer made several interesting observations in the field. At the time of the first cutting of alfalfa a

In the second crop of alfalfa it was again noticed that deficiency symptoms occurred at about the time the first blossoms appeared, in late July and early August. At this time plants on many fields showed the symptoms where they had not been found in the first crop. This would seem to indicate that as the season progressed the supply of available boron in the soil became depleted to the point where the amount was insufficient for the needs of the second crop.

One field observation which seemed to lend proof to the fact that the symptoms in question were actually caused by boron deficiency was the tendency for the symptoms to appear in patches, sometimes so prominent that they could be observed for several rods as one passed along the road. This tendency to occur in patches was also noticed in the case of heart rot of sugar beets.

It was repeatedly noticed in cases where mixed clovers and alfalfa were growing together that where boron deficiency symptoms occurred on one plant they occurred on the others as well.

Mention has already been made of a short survey conducted in late October

to ascertain the extent of boron deficiency injury in sugar beets. An attempt was made to examine a field of alfalfa in the vicinity of each field of sugar beets. It was very evident from the survey that the red and bronze markings on the alfalfa were especially plentiful in those areas where the sugar beets gave evidence that boron was lacking in the soil.

If it is true that the discussed symptoms are indications of boron deficiency, and it would seem that the greenhouse pot tests are sufficient proof, there is a large aggregate area of the upland soils of Michigan which is sufficiently lacking in boron to produce the characteristic symptoms. The task still remains to show by field experiments that such deficiencies are economically injurious. It seems logical for the present, however, to assume that any agency which results in the death of alfalfa and clover leaves before harvest time, and in such serious disorders in the sugar beet, must surely affect quality and lower yields. Even though the growth of beets was not depressed, a considerable loss would result from the necessity of closer topping to remove the injured tissue. Further reference to figure 4 shows why this would be true.

A word of caution is advisable regarding the chance for confusion between the boron deficiency symptoms occurring on alfalfa and clover and other discolorations which may occur. There are other conditions which may lead to red markings on the leaves of these plants, and in many cases it will be necessary to resort to other methods of checking the boron content of the soil before it is definitely classed as being deficient in this element. Perhaps a chemical test of the soil or plants is the best answer to this problem.

Summary

During 1936 and 1937 field plat experiments were conducted to determine the efficiency of borax as a control for heart rot of sugar beets. During the course of these experiments it was observed that heart rot is quite common in certain sections of Michigan, and that certain characteristic symptoms indicate the presence of this disorder and consequently the lack of boron in the soil.

As a result of certain experiments with several crops grown in quartz cultures in the greenhouse, characteristic boron deficiency symptoms were also established for alfalfa, red clover, alsike clover, and sweet clover. From these investigations certain conclusions and observations follow:

1. Where heart rot of sugar beets did not occur, no increases in yields resulted from applications of borax. Broadcast applications as large as 80 pounds of borax per acre were not toxic to sugar beets in 1937.

2. It was shown that certain physiological disorders observed in sugar beets were the same as those described by Brandenburg and Kotila and Coons as heart rot caused by boron deficiency. A brief survey furnished indications that boron-deficient soils occur in localized areas in Michigan and in patches in the fields.

3. Increased yields of alfalfa resulted from applications of small quantities of sodium tetraborate. Some of the leaves of plants growing on boron-deficient soils turned red and bronze at the blossom stage. Within a few days after becoming red, the leaves turned yellow and soon died.

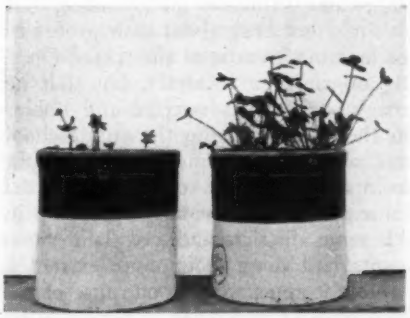

Fig. 7. The effect of boron on the growth of alsike clover in quartz cultures. Left, no boron; right, 0.002 gms. $Na_2B_4O_7$.

4. Boron deficiency symptoms in red and alsike clover were very similar to those on alfalfa. Greatly increased yields of alsike clover as a result of applications of sodium tetraborate were obtained. Earlier maturity resulted from such applications.

5. Sweet clover also responded to boron treatment. Pronounced yellowing occurred in sweet clover growing on boron-deficient sand, but the reddening of the leaves was less prominent than in the case of alfalfa and the common clovers.

6. No response was obtained from applications of sodium tetraborate to sand cultures planted to barley, beans, buckwheat, corn, oats, and rape.

7. In the field, boron deficiency in alfalfa occurred in patches and was particularly prevalent in the areas where heart rot of sugar beets was serious.

8. Where boron deficiency symptoms occurred in fields of mixed alfalfa and clover they invariably occurred on both crops.

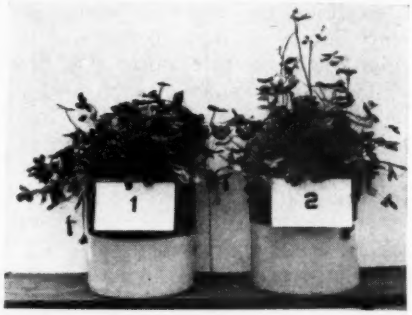

Fig. 8. The effect of boron on the maturity of alsike clover in sandy loam soil cultures. 1. No boron. 2. Three lb. $Na_2B_4O_7$.

9. A considerable aggregate area of Michigan soils is apparently deficient in boron for sugar beets and the leguminous hay crops. A more detailed survey, accompanied by soil tests, will give more information regarding the extent of the area, and field research will be necessary before the economic seriousness of the deficiency can be determined.

Present for Roll Call

(*From page* 5)

for him. Land values rise in such districts, he said, and this protected his extensive private loans to farmers. Then we asked the sturdy and modest farmer what he saw in it. His reply was that he had donated much time in school affairs and wanted to donate more, that he could not brag about cash profits to his farming because of the school (having no children himself), but that he imagined life was sweeter and nobler on the whole because the rural school was attractive to pupils and taught them simple things of agricultural value. Both of these chaps grew up in the same district, and yet their viewpoints had come to opposite extremes.

Now it appears that one cause of the decadence of objectives in rural schools has come from emphasis everywhere in public affairs and legislatures upon support for institutions of research and higher education, with far less thought for country districts than their influence deserves. A few purposeful farm folks have always had to bear the brunt of improvements out there, and only a relatively few legislators have taken up the drive in an effective way. Instead of their shouting for lower taxes, it would have been stronger for them to have campaigned on the issue of giving farm taxpayers more return for their money. You won't hear so much cussing about taxes when our schools deliver the goods.

There's a heap of joy in seeing a farm leader do a good job defending and supporting the ideals of rural life, especially when he is educated *toward* and not *away* from home. I heard a debate lately beween a hard-boiled, university

and law-trained labor boss and a discerning farmer with an educational background of leadership experience. There was "nothing to it," my friends. The labor agent avoided each pointed issue wherein farm and labor are at odds and railed against fancied enemies and vague bogies. Straight as a die the farmer took the labor leader into camp and stripped the sophistry from his thesis. Tax money wasn't misused when they educated that farm lad, and so let's spend more in the same way.

ONE cannot avoid recalling the ancient high school of my teens and of yours. It was the cross-roads just beyond the weedy yard wherein the one-room rural school languished in neglect. Of course in those days high schools were not within geographic reach of many country towns. Travel was slow, and the children had to board a week at a time, buy books and new clothes, and take what pickings they might find of value to their traditional lives. Farm parents sent their kids to nearby cities or county seats to absorb a smattering of imaginary gloss which passed for small-town culture.

No township tuition was paid then as it often is today. Every man for himself, and the teachers for nobody! Many of these rather bashful "freshmen" emerged as scholastic champions, and got the best grades and positions in subsequent teachers' institutes or normals. Others merely used their big shoulders and muscular biceps to become outstanding backfield performers in the autumnal gridiron struggles, and were much sought after for that reason alone. Individually some of them got a lot out of high school, but their home communities got little.

If anyone had suggested bringing a pig into the school or identifying common weeds and field seeds, talking crop rotations or "manure," the faculty would have resigned. Our old principal delighted to lecture on physics and harass us at rhetorical inquisitions, post debates on woman suffrage and immigration, but he would have fainted at giving country pupils a work-out in a milk-testing lab.

Since then we have come a long ways ahead. That same high school is chiefly noted for its winning teams in stock judging, its hybrid corn plots, and the ability of the farm class to build a shop annex and operate a dairy herd improvement association. A girl from that school won the State sewing championship, and maintained double-A grades in the old-style cultural courses meanwhile. Yes, and I presume a few of the huskier ag lads still make their mark in football (or make it on somebody else) with as much eclat as of yore. I have always felt that there is nothing wrong in sticking to useful knowledge, and it needn't crowd out the literature and classics either, or stop a man from making a touchdown.

Of course things *had* to pan out that way in the relation of country towns and rural zones. Hard-surfaced roads and instant communication, radio and electricity—all these and other modern mutual conveniences throw farms and city wards into a huddle unknown to my rising generation. Indeed we have experienced such a change that quite often we see city-bred boys absorbing the culture of agriculture at high school —and what is stranger yet, farmers actually hiring them in summertime!

NATURALLY, with the first flush of enthusiasm over these additions to the sanity of rural education, our leaders sometimes overshoot the target. In my State we are devoted to agricultural cooperative marketing and dairy farming. Consequently, a number of zealots in both ranks like to use the school system to put over theories and percepts. If they may do so without getting a touch of religious partisanship or crude propaganda into the system all goes well. However, in some cases the insistence upon certain standard formulas of cooperative marketing or nationistic dairy viewpoints hampers the individual freedom of thought which free schools should foster.

Carried to senseless extremes it not only burdens the youthful teacher with more subjects beyond her ken, but it contributes to a state of mind bordering on instability in public affairs. For example, along with these compulsory subjects we have had State laws which made it a crime to criticise cooperatives vigorously or to serve a meal in a restaurant minus cheese. Is that an open invitation to grave abuse in cooperative management, and does it really encourage the production of good cheese?

Far be it from one so observant as I pretend to be to claim that country schools should avoid economics or sociology. These topics are to agricultural education as butter is to bread. Dedicated as we seem to be to a system of commercial farming, one cannot neglect the underlying facts of the situation. But it is hard not to inject opinion and prejudice into any treatise on this subject. The border line between history and hysteria is too close for comfort when teachers tackle them.

At home we are passing through the dense fog of another violent campaign to elect a set of State and local officers. They must have forgotten a lot they learned in common schools. Many of them detour around the bad spots in the road to progress and vaporize in thunderous platitudes about conditions and circumstances far beyond the realm of their fellow citizens. Is it a too frequent American trait to lambast somebody too far off to fight back, rather than to risk your political hide in fencing with adjacent abuses?

ONE remedy for that I believe would be for our normals and universities to arrange somehow for a greater exchange of teachers between different geographical sections of this country. By this I do not mean to keep these teachers strictly in the upper class rostrums, but to find ways to sift them right out in the open country, to the one-room schools, the graded schools, and the rural high schools too.

Despite the continental journeys taken by families in motor cars back and forth, we still lack a realistic approach to fundamental varieties of tradition and thought now animating let us say, the North and South. Hurried glimpses never educate, and gas stations and tourist cabins are not good places to learn these things well.

Neither do we find a ready answer by conning over the congressional record or scanning the vapid opinions of newspaper columnists. Association in the class room—if all narrow bitterness be avoided—would to my mind reduce much of the hazard we face today in a country united by land and laws but misguided by prejudice and sectional misunderstanding.

WHEN I was a youngster we often had an exchange of ministers in the pulpits of sectarian denominations. In time we grew to forget the isms and oddities of the other man's church in a high regard for the decency and culture of their parsons or priests. May this not also work to some degree in the improvement of Americanism at a time when we ought to train school pupils in broad outlooks and faith in democracy?

I admit it has its dangers, if we allow the same forces to butt into the school business that have obstructed so much progress in the past. We can't let the politicos pick the exchange teachers, or let any pressure groups dominate the scholastic field when this is attempted. It would be hard to engineer at first, and only a few experiments would be possible. But it is in this direction we must go eventually or we will kill our educational aims with a gas blast of provincialism worse than we ever had in the McGuffey reader days.

Yet, despite overcrowding and a sense of futility and drifting, I am one who points with pride to the quality of our common schools. If I could shake off some laxity, laziness, inertia, and about two score years to boot, you could count on me to occupy the front seat and holler "Here" every morning! And most of my readers would pity the teacher!

LINED UP

Little Algernon (to the old lady who has just arrived, and whom he has never seen before): "So you're my grandmother, are you?"

Old Lady: "Yes, on your father's side."

Algernon: "Well, you're on the wrong side; I'll tell you that right now."

Mose—"Ah sho' is glad Ah wasn't King Solomon."

Rastus—"Whaffer yo' has dat 'pinion?"

Mose—"Huh, huntin' up washin's foh one wife keeps me plenty busy."

He: "You are always wishing for what you haven't got."

She: "Well, what else can one wish for?"

FARM SENSE

Teacher—"Johnny, if five sheep were in a field and one jumped out how many would be left?"

Johnny—"There wouldn't be any left. You know arithmetic, but you don't know sheep."

When the average man argues with a woman, the final result usually is: "He came, he saw, he concurred."

She: "I hear that the chief of police is going to try to stop necking."

He: "I should think he would—a man of his age."

DELAYED JUSTICE

Mother, "Johnny, I told you to count 50 before you did anything to your little brother. And now I find you holding him in the closet."

Johnny, "Yes, Mother, I'm counting 50. But I want to be sure I know where he is when I get through."

Middle age has compensations: Fewer things afford enough kick to make your conscience bother you.

Liza: "Dat no-count Mose tol' me las' night ah looked positively ethereal in the moonlight."

Mandy: "Whut do dat mean?"

Liza: "Ah dunno, but ah done slapped his face so's to be on the safe side."

"Dear Editor:

"After two years of married life, my husband and I find we have made a mistake. Should we separate?"

"Yes, by all means. But what are you going to do with the mistake?"

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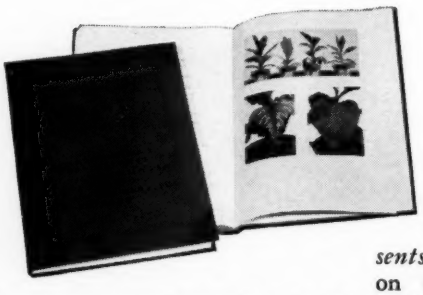

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